FEB 28 1921

More than 25,000 Copies per Week

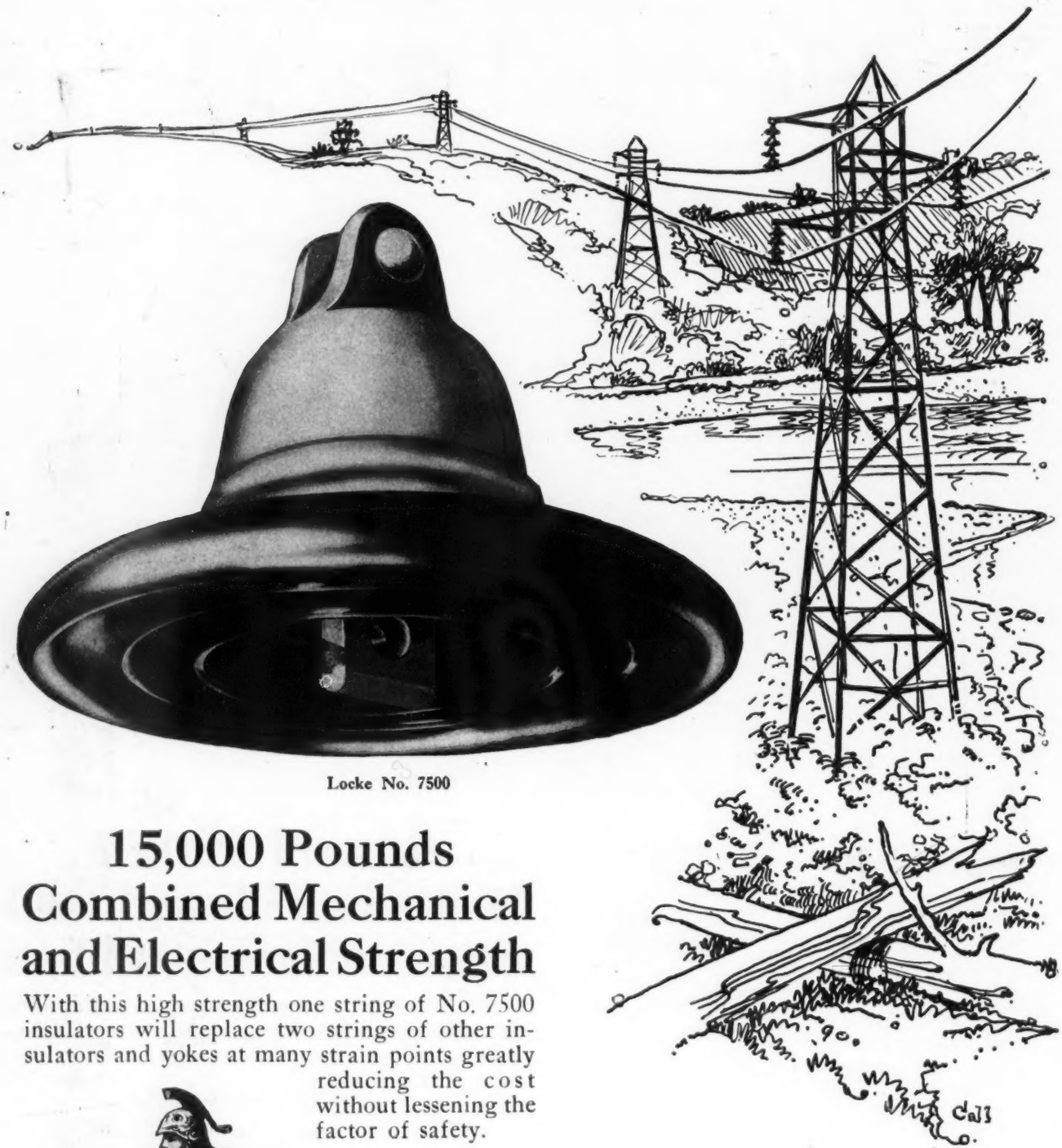
Electrical World

McGraw-Hill Company, Inc. New York, February 26, 1921 Twenty-five Cents a Copy

For the Small Central Station

TERRY TURBO GENERATOR UNITS of 1,000 K.W. and smaller possess many valuable features which warrant your investigation. The turbine is of the Composite design type, a combination of two types of elements, a high pressure and low pressure, using each element over its most efficient range. Their operating records in many plants have proved them both dependable and economical. Write for complete information.

The Terry Steam Turbine Co.
Terry Square
Hartford, Conn.



Locke No. 7500

15,000 Pounds Combined Mechanical and Electrical Strength

With this high strength one string of No. 7500 insulators will replace two strings of other insulators and yokes at many strain points greatly reducing the cost without lessening the factor of safety.

Locke Insulator Mfg. Co.

Victor, N. Y.

VICTOR INSULATORS

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

W. H. ONKEN, Jr., Editor D. H. BRAYMER, Managing Editor
S. B. WILLIAMS, Assistant Managing Editor A. M. PERRY, Engineering Editor J. C. MARTIN, Western Editor G. E. ARMSTRONG, Pacific Coast Editor H. S. KNOWLTON, New England Editor
Associate Editors: P. S. BIEGLER, C. T. BALDWIN, S. N. CLARKSON,
R. H. BACON, T. P. KINDIG, R. M. DAVIS, E. H. HUBERT, F. C. WELLS

Volume 77 New York, Saturday, February 26, 1921 *Number* 9

A Point that Should Be Made Clear to the Unthinking

POLITICIANS who seek to win popular support by favoring the abolition of the public service commissions presumably aim at a direct exercise of the police power of the state through legislation or by authority vested in municipalities in place of its delegation to a regulatory body. Assuming—for argument's sake only—that the main interest of the consumers in public utilities is to get service at the lowest possible price, this is not the way in which it is most likely to be done. Legislators may enact, but in the background stand the courts and the Fourteenth Amendment, and it needs only a superficial acquaintance with the trend of legal decisions in protested-rate cases to make it clear that while state and federal courts almost always treat commission rulings with the respect due to the findings of competent and impartial bodies exercising judicial functions, they are not habitually tender to statutes attacked as confiscatory. We are here neither praising the commissions at the expense of the courts nor the courts at the expense of the commissions, but merely suggesting that along the line indicated a doubt might with entire propriety be instilled into the minds of unreasonable consumers as to whether, from their own perverted point of view, it would be wise to get rid of the ills they think they have only to run into others that they know not of.

National Survey of Waste in Industry

WASTE is an economic problem. It connotes idleness, duplication of effort, competition, unnecessary expenditure of resources or of human effort, lack of co-ordination and standardization, improper use of the mechanism of production and distribution and other such conditions. If, therefore, waste is to be discovered and its effects overcome, the job must be taken up by technicians and engineers, who alone of all men are trained to search out, collate and interpret facts dealing with production and utilization. This the American Engineering Council proposes to do, for it has set itself the task of making a national survey of waste in industry and suggesting some practical plan for amelioration. It goes without saying that if the problem is approached in the proper spirit and the economic process as a whole considered, the study will be exceedingly profitable, more especially if it shall also reveal the best way of doing things as contrasted with existing methods. With a man like Herbert Hoover at the head of such a survey, the problem is certain to be handled in a big and broad way, with full recognition of the cost of reconstruction. The average reformer, even though he be an engineer, is very apt to overlook realities in his enthusiasm for the ideal. Nevertheless, we are all of the earth earthy and are not inclined to dispense with present methods for others admittedly better but whose economies are offset by the large expenditure of money or labor necessary to their adoption. All waste is not uneconomic, and therefore many new and better methods are for the time being prohibited. Actual wastage in this country, however, is tremendous, and the American Engineering Council can, if it will, be the prophet of a new and infinitely better industrial era.

Another Notable Record for the West

UNDER the lash of an urgent demand for more power when almost the whole of the State of California was suffering from the lack of sufficient rainfall, with the consequent decreased outputs from hydro-electric plants and increased demands for electric power for pumping irrigating water, the San Joaquin Light & Power Corporation constructed in fifteen months a hydro-electric generating station rated at 50,000 hp. The design of the plant embodies features of the most successful developments of the past as well as innovations of its own. Much of the apparatus has been placed outdoors at a considerable saving in cost over indoor construction, as outdoor construction in that territory has been found to be particularly economical, the climatic conditions being mild. It was in the actual construction of the dam, tunnels and station that many innovations were brought into play. The work on the dam was started even before a road was built. The tunnels were mucked by a steam shovel and the muck carried out in electrically propelled cars. In one month 453 ft. of tunnel was driven. Other records in speedy construction were made in laying the penstock and building the station proper. The need of the additional power was so great that at the completion of the plant an unusual popular demonstration of the starting of a hydro-electric station was staged at the site.

"Value of Service" Proposed as Basis of Rates

NO COMMUNITY consumer is entitled to rates from a transmission system that are out of proportion to the value of the service. This thought was dwelt on in our issue of last week by N. A. Kemmish in an article outlining a unit system of wholesale and retail rates. A factor called "value of service" is established for each community or group based on the cost of furnishing its own service, and the total costs of service are apportioned between the various groups on the ratio of any one factor to the sum of all. Each group thus obtains the advantage due it as part of the combined system, but it is given no advantage that its natural

position does not warrant. A great deal of discussion is going on at the present time as to what proportion of system costs a community should bear when a power plant is established in or near that community. Some contend that the location of the plant makes no difference and that the community should bear its pro rata share of the system costs. Others contend that the community should be treated as a separate unit and that none of the system cost should be borne by it. Either position is extreme and ignores the benefits of interconnection. Mr. Kemmish's plan provides a method of apportioning the costs that is well worth careful study. Interconnection on a large scale is developing more rapidly than is generally realized, and the rate problem is becoming more acute as a consequence. Much of the complication is the result of looking at the problem in too much detail in place of first visualizing it as a whole and then working down to details. Mr. Kemmish's article is a praiseworthy attempt in the right direction.

Shall Iron Conductor Be Used?

WHEN to use iron wire and when not is a much debated question. The outstanding physical characteristic developed in all tests and discussions is that the economical current-carrying limit of such wire is low, many placing 5 amp. as a maximum. Whatever this limit may be, it is clear that the value is relatively small and provides a very definite load-carrying limit. The relative prices of copper and iron affect the choice somewhat, but by and large the physical characteristics are the controlling factor. The first consideration in any case is that of future growth. Even though original loads may be well within the capacity of an iron conductor, any probability of growth of load or appreciable extension of lines will cast a serious doubt on the advisability of using it, since the expense of changing together with the interruption of service will far outweigh any temporary saving that its use may make. This usually confines iron wire to the lightly loaded lines where there is no chance of load growth or extension or where the possibility is extremely remote. The question is being extensively debated in connection with the rural service situation of the Middle West, and the general sentiment seems to turn rather strongly against the use of iron wire, principally because virtually every extension is potentially a part of a long line or an extensive network that cannot give adequate service if iron conductors are used.

While there is little question that the use of iron wire will always be relatively small, it must not be forgotten that there is a very definite place for it in short stubs on higher voltage lines where no possibility of load growth or extensions exists and in the sections where physical conditions put a definite limit on line lengths or loads. If its use means the extension of a service, without future embarrassment, that otherwise could not be extended, it can then be seriously questioned whether insistence on copper is a wise policy unless there are climatic or other conditions that will make iron short-lived and a public hazard. The whole question is one on which no general rule can be laid down. It calls for careful consideration in each individual case, and the decision will usually turn on the question as to what the possibilities of future growth are and whether the service justifies the investment in copper.

Tangling Up the Water-Power Situation

THE list which was recently published of water-power applications aggregating thirteen and a half million horsepower seems at first sight to augur immense developments and a vast addition to the industrial resources of the country. It has taken a good many years to get through a reasonable water-power bill allowing the utilization of resources in the national domain, and it now looks as though it would take considerable additional time fully to clear up the conflicts of interest and point of view which have arisen.

Apparently, as a cheerful beginning of difficulties, there is to be a sharp conflict along the line of state rights. This was perhaps to be expected because of the large regulative powers which have already been intrusted to state commissions. It would seem that no particular difficulty ought to be found in reaching a reasonable basis of operations, but the courts are slow, and it is much to be feared that many a project valuable for the community will be buffeted about for no inconsiderable time before it is allowed to come to fruition.

There is very active propaganda at work to keep hydraulic operations out of the national parks, in the belief that nature should here and there be saved from industrial inroads. With this point of view we must confess to a good deal of sympathy, but hydro-electric propositions at least have shown very little disposition thus to intrude on the rights of the public. To our mind the danger to the public comes, not from a desire to grasp improper privileges in national parks on the part of hydro-electric companies, but from the temptation of not altogether disinterested persons to start violent crusades for the establishment of extensions of the national park system with the amiable purpose of working a hold-up game and incidentally obtaining for the benefit of hotel keepers and transportation companies property which might better be devoted to the general service of the power-needing public. The monopolies which have already been granted around national parks will bear very thorough investigation, and we would suggest that they should be subjected to at least as close scrutiny as falls to the lot of power projects.

One thing at least is plainly evident from an inspection of the applications now on file with the government, and that is that they afford no substantial basis whatever for charging the existence of a water-power trust. They are, in fact, of various character, backed by all sorts of interests and having in common only the purpose of stopping the long neglect of hydraulic power and putting the streams which have run to waste at last in a position to contribute something to the public weal. Nobody holds for a minute that investors in hydro-electric enterprises are in the business entirely for their health, but there is not the slightest reason for suspicion that they are banded together for any monopolistic purpose. For the benefit of all concerned the outstanding questions regarding the issuance of permits should be pushed through to settlement as fast as possible, and above all things the United States government, the ultimate potential owner of all these developments, ought to provide an adequate and properly paid force to look after its interests and those of the public whom it is—perhaps by a fine flight of the imagination only—supposed whole-heartedly to serve.

California's Growth a Lesson to Other States

IF THE star of empire is ever to speed its way to the regions of the setting sun, electricity must be its harbinger. Right now it stands glittering above the town of Spencer, Ind., having moved less than ten miles during the last decade. But for the growth of population in California (due in large measure to the application and utilization of electricity) the center of population in the United States would have begun retracing its steps. No longer do the tillers of the soil outnumber the mechanics and artisans of our towns and cities. It is not so evident now as in the days of Bishop Berkeley that "westward the course of empire takes its way." Yet there is no doubt that the nation would be far better off if the population were more evenly distributed. Herding of people in towns and cities, with the attendant congestion and waste, can never be conducive to the proper development of any race; and here is where the saving grace of electricity can be brought into play, for it matters not whether the country be agricultural or industrial, all industry is amenable to its cultural influence. Are the boys to remain on the farm? Then they must have some of the comforts and advantages of city life, and those electricity can give them. It has done it in California; it can also do it elsewhere. Power is available wherever an electric line exists, so that industry is no longer constrained in that regard, and labor is more contented in the houses and gardens of model communities than in the stifling and stunting atmosphere of crowded tenements. No other state has applied electricity to the satisfaction of its wants like California, and what vast improvements can be made by that means! Gold, oil and climate may have been the lure that drew men to California, but it was electricity that kept them there and gave them contentment. Industrial and agricultural reformations are surely needed in this country, and what but electricity can bring them about?

The Interpretation of Statistical Data

AN INSTRUCTIVE study of the conditions about the Worcester (Mass.) load center, with special reference to probable gain through interconnection, is published in our columns this week. We have long consistently preached this policy, and it is doubtless wise in the present instance. Yet we cannot refrain from calling attention to the need of more care in the co-ordination of the statistical data if the deductions are to be fully convincing. It is not always averages that are the important thing in such a case—sometimes the variations from the average are more significant from the economic standpoint. One of the striking facts here is that taking the plants as a whole there was in capacity only a scant 11 per cent above the sum of the peaks. This indicates serious deficit in capacity, but where was it—in numerous small plants or in one or two conspicuous big ones? The particular remedy to be advised depends not on the average but on the answer to this question. It appears, too, that the average coal consumption was 2.65 lb. per kilowatt-hour. Very good; but how did the plants of varying size go to make up this average? If the figure is due to general bad performance of the plants under 2,000 kva., interconnection will help matters greatly by wiping out the worst cases. If, however, the average is due to operation of one or two large plants at bad daily load factor, strictly local treatment may have to be applied. Broadly, the situation shows probably large opportunity for interconnection, but until the variations from the averages are discussed the nature of that opportunity and the real gains that may be made cannot be disclosed. Moreover, when the interrelation with hydro-electric power is considered averages must be scrutinized even more closely, since a plant of great value in conserving power supply may seem uniquely bad in a less important particular.

Cable Temperature Research Is Flourishing

THE elusive problem of the temperature of underground cables in its relation to their life and rating has recently been attacked with new vigor, as witnessed by the A. I. E. E. convention report in this issue and by articles in recent foreign periodicals. From the increasing number of reports of study and observation there is good promise of an ultimate orderly basis for design and selection of cables for specific duties. The problem in its ultimate elements is a simple one, a known amount of heat energy liberated in a linear conductor and to be dissipated at some neighboring base temperature. Moreover, within the cable at least there is symmetry of the heat paths and easy opportunity for studying the thermal properties of the insulation. But this is very nearly all that can be said.

Within the cable the insulation, on the other hand, shows wide variation in properties. Dielectric losses develop at relatively low temperatures, but in many cases cables operate continuously at temperatures far above conservative standards. The life of the cable as dependent on temperature alone cannot be said to be known. Nor is it particularly important, as the temperature, dielectric stress and mechanical handling in combination are the determining factors. Cables must operate at stresses far below the dielectric strength of the free insulation. Even the heat conductivity of the insulation shows wide variations.

Outside the cable the properties of the heat paths for the losses have proved very difficult to pin down. Even in the simplest case of a cable buried directly in the soil the heat conductivity varies widely both in location and season. Although the base temperature is taken as 40 deg. C., summer values as high as 55 deg. are reported, and obviously winter values of 0 deg. and lower are possible. In duct structures further irregularities are introduced by the air layer around the cable, the walls of the ducts and the number of ducts in the structure. Here, too, observations show the widest discrepancy.

Imperfect knowledge and control of the electrical and thermal constants of the materials both inside and outside of the cable therefore present a fruitful field for investigation, in which there is now unusual activity. Discussion of the matter at the A. I. E. E. convention indicated that the members do not feel there is yet sufficient information concerning hot-spot temperatures and methods of measuring and controlling them to justify higher temperature ratings.

If the information that is needed for reaching more definite conclusions is formulated by cable manufacturers and operators the National Research Council, which has this subject under consideration, should be able to furnish the desired data.

Louis Kossuth Comstock

Originator of the Conference Club idea and leader in the movement to make electrical contracting a bigger, better and more profitable profession

NO MATTER how big a job some men have they are always able to devote time to the upbuilding of the industry in which they are engaged. To these men the industry owes much of its progress and broad conception. Such a man is L. K. Comstock, president of L. K. Comstock & Company, New York, the well-known firm of electrical engineering contractors. It is doubtful if there is any one who has done more to broaden the field of the electrical contractor, to bring him into closer touch with the other branches of the electrical industry and to establish electrical contracting as a profitable business. It was he who gave to the industry the Conference Club idea, first as a means for stabilizing the labor situation in the contracting field and later as a forum where common problems might be openly discussed by recognized leaders among electrical engineers, contractors, central-station men, manufacturers and jobbers. The Open Price Association of New York City for the comparison of bids was another broad co-operative movement established through Mr. Comstock's initiative.

Although an engineer by training and experience, Mr. Comstock is an idealist in business and a true philosopher in the affairs of men. With unaffected open-heartedness and sincerity, his ambition to better the conditions in the electrical contracting field is everywhere recognized as finding its fulfillment in self-sacrificing leadership. Furthermore, Mr. Comstock is an organizer. It is one of his cardinal principles of business to delegate details to others and devote his own time to constructive planning for the future, not only of his business but of those divisions of the electrical industry in which the electrical contracting engineer is destined to play so fundamental a part. His was the first electrical contracting engineering firm to establish a sales organization to go out and sell his company's engineering services. In this policy lies the key that explains the volume of his business, which now is approximately $10,000,000 a year.

Mr. Comstock was born in Kenosha, Wis., Jan. 8, 1865, and was graduated from the University of Michigan in 1888. Although the electrical industry was then in its infancy, it appealed to the young man. He joined the staff of the Marr Construction Company of Pittsburgh, afterward the North American Construction Company. After four years in this work he moved to Chicago, where he went into the construction business for himself. The business panic of that era, however, forced him to close, and he entered the employ of the Western Electric Company as superintendent of construction. In 1900 he became electrical and mechanical engineer for the George A. Fuller Company in New York, but the desire to enter the construction field on his own account would not down. Consequently, in 1904, he launched the firm of L. K. Comstock & Company, an organization which has offices in three large cities of this country and one in Canada and heads the list of firms specializing exclusively in electrical contracting work.

How Far to Carry Industrial Metering

Extent of Industrial Plant Metering Should Depend on the Cost-Accounting System in Use—Power Cost May Be Distributed as Overhead Expense or Direct Manufacturing Cost—Practical Methods

By W. B. TODD

Engineering Department, Du Pont Engineering Company, Wilmington, Del.

IN THE modern industrial plants of today the extent to which metering of the electrical load should be carried depends upon the cost-accounting system in effect. The latter, in so far as the electric power costs are concerned, will vary with the nature of the product manufactured and with the degree of accuracy to which detailed costs must be computed.

Electric power cost may be considered as a direct manufacturing cost or may be distributed as an overhead expense. In either case the total monthly consumption of power and its cost must be definitely known. Where the factory has its own power plant it should be run as an independent unit and sufficient metering done and records maintained to furnish accurate data on the power generated and the cost per kilowatt-hour, including overhead. Where power is purchased the power bills show this consumption and cost monthly.

Whether the power cost is distributed as an overhead expense or applied as a direct manufacturing cost, the result will be the same if either method is carried to the same detail. As a direct cost it may be applied on either a machine-hour or a unit-production basis. To obtain the cost on a machine-hour basis power tests must be made on each machine performing an operation on the articles manufactured, and if the average load varies for different articles, the tests should cover this information. The machine-hour power charge on each machine may then be computed for each article manufactured, and the monthly power cost chargeable to each article depends upon the time required on each machine to furnish the actual monthly production of that article. This system of charging costs is quite expensive, as it requires considerable testing and accounting and is justified only where keen competition demands that the manufacturing cost of each article be accurately determined.

Where different products are manufactured, each having its own individual machinery, the power cost per unit of product, such as 1,000 lb., may be determined from power tests showing the average consumption required to manufacture this amount.

In either of the above methods there will be a discrepancy between the total power costs assignable and the actual total power cost caused by change of machine loads due to stock or operating conditions. This discrepancy may be distributed in three ways, all of which will give the same result: (1) Distribute the discrepancy over all estimated power costs according to their percentages of the total estimated cost; (2) take the estimated individual percentages and apply them to the total actual power cost; (3) adjust the rate per kilowatt-hour and apply the adjusted rate to the estimated consumptions.

In modern cost accounting the aim is to use all costs estimated from detailed studies. If the total actual costs differ from those estimated, the discrepancy should be distributed pro rata. If the discrepancy passes the point considered allowable owing to ordinary fluctuating conditions, an investigation should be made to determine whether the estimates were wrong or whether costs are increasing because of increased labor or material expenses or poor efficiency in operation, planning or management.

Where the electric power cost is considered as an overhead expense, a question arises as to its distribution. In factories making only one product, fabricated in only one form or style, the power cost along with all other costs is chargeable to that one product and no cost-accounting system should be necessary. However, where products in different forms are manufactured, departmental—and in many cases more accurate—metering is required if exact overhead costs on each product

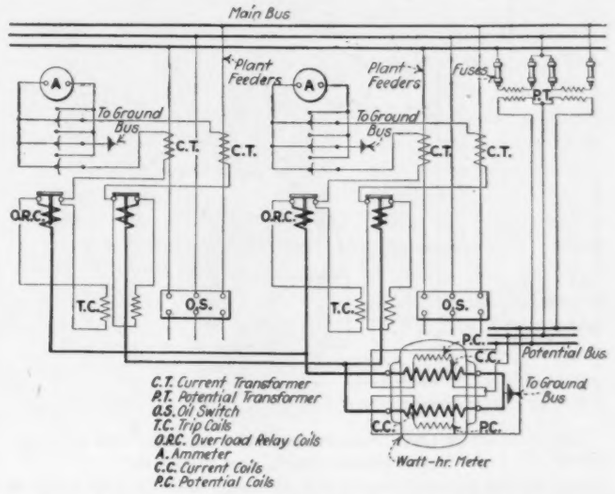


FIG. 1—IN THIS LAYOUT ONE METER IS USED ON TWO FEEDERS, BUT THE CONSUMPTION MAY BE APPORTIONED

The current coils of the meter are twice the capacity of the current transformer secondaries. The total load on both feeders registers on the watt-hour meter, but by throwing the ammeter switches the proportional consumption for each feeder may be determined.

are to be obtained. In many cases the application of the general overhead to all products manufactured results in a selling of certain of these products below cost, although the sale of the entire collective product may show a reasonable profit if the proportion of profitable products sold is great enough. A large number of industrial failures can be attributed to this cause alone.

Before it has been definitely decided to what extent power costs should be obtained the electrical engineer should submit an estimate of the cost of installing the necessary meters or conducting the required tests, and this cost, together with that incident to compiling the cost data, should determine whether the expense is justified for the results that will be obtained.

Departmental metering may be carried out in fact by

the use of watt-hour meters or by making occasional power tests with portable instruments to determine the proper ratio of average departmental load as compared with the average total plant load. Where a department may be shut down for a certain time, the watt-hour meters will take care of this condition; but with the tested ratio method the distribution should be made on the basis of department-days or department-hours. This will increase the percentages of the other departments, but owing to the decrease in the total electrical consumption, the actual monthly cost per department should remain the same unless the cost per kilowatt-hour varies owing to the change in monthly load factor.

GENERAL METERING METHODS

If departmental metering can be done at the power house, the line losses are accounted for; but if the departmental circuits are not run separately and the

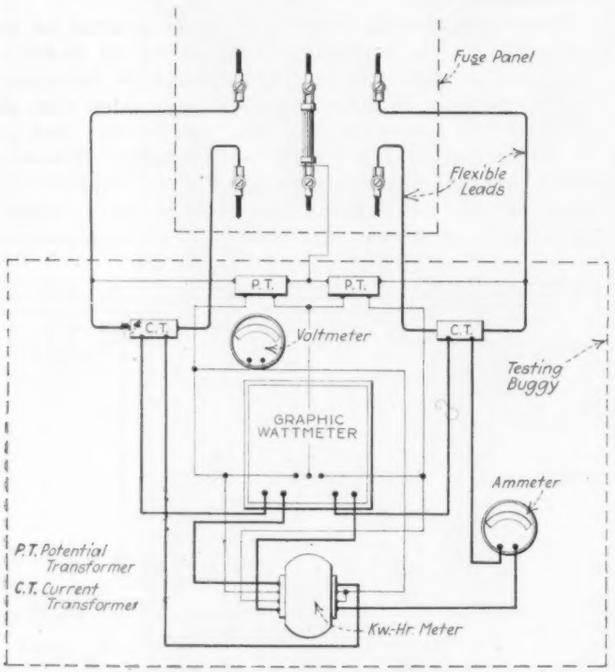


FIG. 2—MOTOR-LOAD CONDITIONS MAY BE CHECKED AT THE TIME POWER COSTS ARE CHECKED

The wiring layout is for a testing buggy now used in many up-to-date industrial plants for checking motor conditions and energy consumption. This particular arrangement of instruments has been used with good results in plants of E. I. du Pont de Nemours & Company and the General Motors Company.

metering is done at the department service entrance, the difference between the sum of the departmental consumptions and the total consumption at the switchboard in the power plant or at the electric service company's meter should be distributed according to the ratio of the departmental loads to the total load. Fig. 1 shows a scheme that has been used in an industrial substation whereby the load on two feeders furnishing power to one department was metered by one 10-amp. watt-hour meter, yet the ammeters gave directly the proper division of load and indicated the condition of each circuit as affecting current-carrying capacity. The current transformers have 5-amp. secondaries.

The cost of lighting is often distributed either on the basis of the number of square feet of manufacturing space in each department or according to the departmental connected lighting load. These methods do not take into account the "load factor," which may differ considerably in the various departments because of operating conditions and the natural light available during the daylight hours. They afford no check on the amount of light wasted, and, particularly where the energy for lighting must be purchased at a higher cost per kilowatt-hour than for power, departmental metering with checking of comparative consumption will in many cases soon pay for the installation of the meters.

Testing by means of portable instruments has been mentioned above, and the arrangements for this work should depend upon the amount of testing necessary. For occasional testing separate instruments may be used as needed, but in large plants where considerable testing is done either for power costs or for miscellaneous metering to determine loads on circuits or individual motors, friction loads of drives, power-factor conditions, etc., it is most convenient to use a testing buggy with rubber-tired wheels. This buggy may be pushed around the floors and taken from floor to floor by means of the freight elevator. On this buggy can be mounted and wired up completely a graphic wattmeter, a watt-hour meter, an ammeter, a voltmeter, current transformers and, if necessary, potential transformers. With these instruments wired up as shown by Fig. 2, it is only necessary to handle for three-phase work the four current leads and the one potential lead. Where possible the "cut-in" on the circuit should be made at the fuse panel ahead of the motor or circuit to be tested, in which case the current leads can have terminal lugs taken from blown or renewable fuses, and in many cases the heavy capacity type of spring testing clips may be used. The potential lead need only be hooked on the end or the lighter-capacity type of spring clip can be employed. Rapid "cut-ins," without shutting down the motor or circuit, may be made by a helper holding the ends of a "jumper" at the terminal ends of a fuse block, while the tester pulls out the fuse and inserts or attaches the terminals of the current leads in or to the fuse block. This outfit enables the kilowatt-hour consumption, current, voltage, power factor and kilowatt load to be obtained, and where the load fluctuates considerably and frequently the maximum, minimum and average load can be accurately determined. The graphic wattmeter is particularly useful in studying cycles of operation. The current transformers should have enough ratio taps to take care of the range of motor horsepowers installed in the factory, or the ratios may be taken care of by two sets of transformers.

ALL SURVEYS AND TESTS MADE AT THE SAME TIME

In many factories the testing of friction loads should be made to determine the correctness of motor locations, the alignment of shafting, the conditions of bearings and the tension of belts. These tests, in connection with those on individual motors to determine actual capacity needed to take care of the load pulled, will in most cases show that considerable power savings may be made by rearrangement of motors and drives and the use of ball or roller bearings. This information can be acquired while conducting the tests for power costs and will reduce considerably the test expense chargeable to the latter.

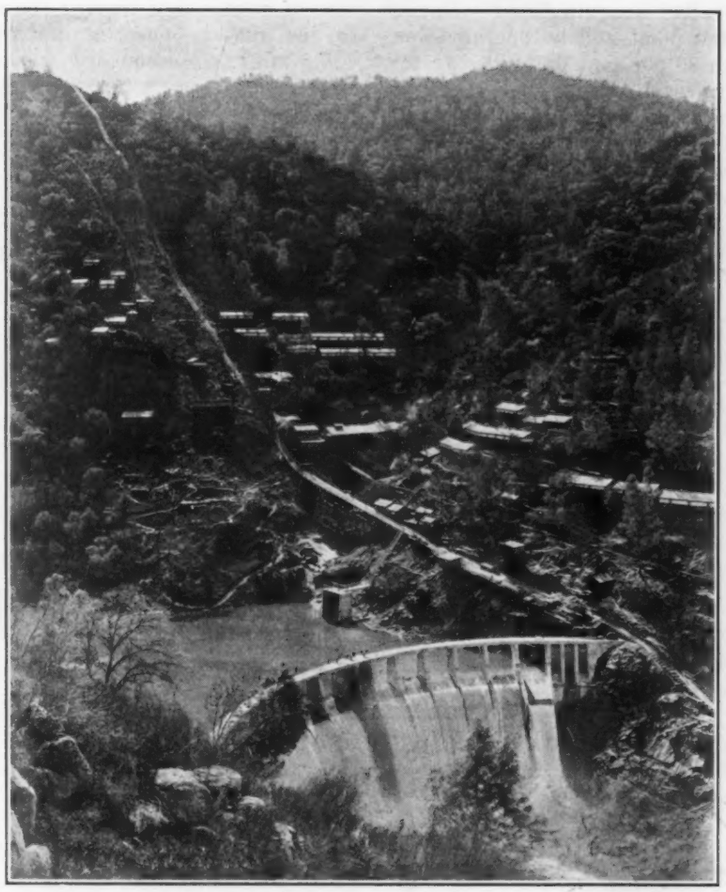
The electrical engineer of a plant should become familiar with the methods of handling electric power costs and should work in conjunction with the accounting division in order that metering may be arranged for but not carried beyond the point of necessity.

Hydro-Electric Plant Built in 15 Months

Methods that Were Employed to Hasten the 50,000-Hp. Kerckhoff Development Which Was Undertaken to Relieve Power Shortage Resulting from Postponement of Construction During War Period

By R. C. STARR
Construction Engineer San Joaquin Light & Power Corporation, Fresno, Cal.

DURING the war it was impossible for the San Joaquin Light & Power Corporation, as it was for other California companies, to increase its power-plant installations. As a result it found itself in the spring of 1919 with 4,100 unfilled applications on file for a total of approximately 40,000 hp. and with no power available to supply the demand, despite the fact that it had ample capacity for its load in 1914. Consequently it was necessary to install at the earliest possible date a plant of approximately 50,000 hp. rating. At that time the company had preliminary permits covering the total development of approximately 200,000 hp. on the north fork of the Kings River and on the San Joaquin River, but the Kerckhoff development on the latter was the only one which could possibly be constructed in a period of less than two years. Furthermore, the rapid increase in the price of oil made the company hesitate to take care of the entire increase in load by an increase in its steam-plant capacity, although a steam unit was installed in the Bakersfield plant in the summer of 1919 to take care of the spring load of 1920. The Kerckhoff plant also proved to be a relatively cheap development per kilowatt. These factors made its construction doubly valuable to the company at the time, and therefore construction was authorized late in the spring of 1919. By employing the latest ideas and methods in construction the work was so greatly expedited that the entire development was completed just fifteen months later, making it the first hydro-electric plant to be completed in America after the war.



ALL CONSTRUCTION MATERIAL HAD TO BE CONVEYED DOWN A 2,700-FT. INCLINE WITH MAXIMUM GRADE OF 92.5 PER CENT

The Kerckhoff development, which is on the San Joaquin River 40 miles (64 km.) northeast of Fresno, consists of an arched dam 125 ft. (38 m.) high and 570 ft. (174 m.) long across a narrow gorge in the river; an 18-ft. x 18-ft. (5.4-m. x 5.4-m.) tunnel 17,000 ft. (5,180 m.) long through a granite mountain; three steel penstocks, each 950 ft. (289 m.) long feeding three water-wheels, each of 20,000 hp. rating; a reinforced-concrete power house with an outdoor high-tension bus and transformer station; a 110,000-volt transmission line, 110 miles (177 km.) long, and three reinforced-concrete substations in the San Joaquin Valley. The dam is a constant-angle arch dam, built in a narrow horseshoe bend in the river, about 2 miles (3.2 km.) below the company's power house No. 1. The storage thus formed impounds 4,000 acre-ft. (480 hectare-m.) of water, 3,000 acre-ft. (360 hectare-m.) being above the pressure tunnel. This will permit operation of the plant at full load for thirty-six hours during the dry season. More storage could not be provided at the Kerckhoff dam because station No. 1 limits the maximum elevation of the pond. However, the natural flow of the San Joaquin River, with a drainage area of 1,800 sq.miles (4,600 sq.km.) is augmented by water stored by other projects on the San Joaquin River and its tributaries, consisting of the Crane Valley reservoir, with 52,000 acre-ft. (6,300 hectare-m.) of the San Joaquin Light & Power Corporation, and the Huntington Lake reservoir, with 90,000 acre-ft. (10,800 hectare-m.) of the Southern California Edison Company. Future developments by the Southern California Edison Company at Shaver Lake, Florence Lake, Blaney Meadows, Vermillion Valley, Pitman Creek and other places on the middle fork of the San Joaquin River will increase the mountain storage of water by 300,000 acre-ft. (36,000 hectare-m.).

Like all California streams, the San Joaquin River is subject to floods during a period of approximately six months, during which time the flow of the river is

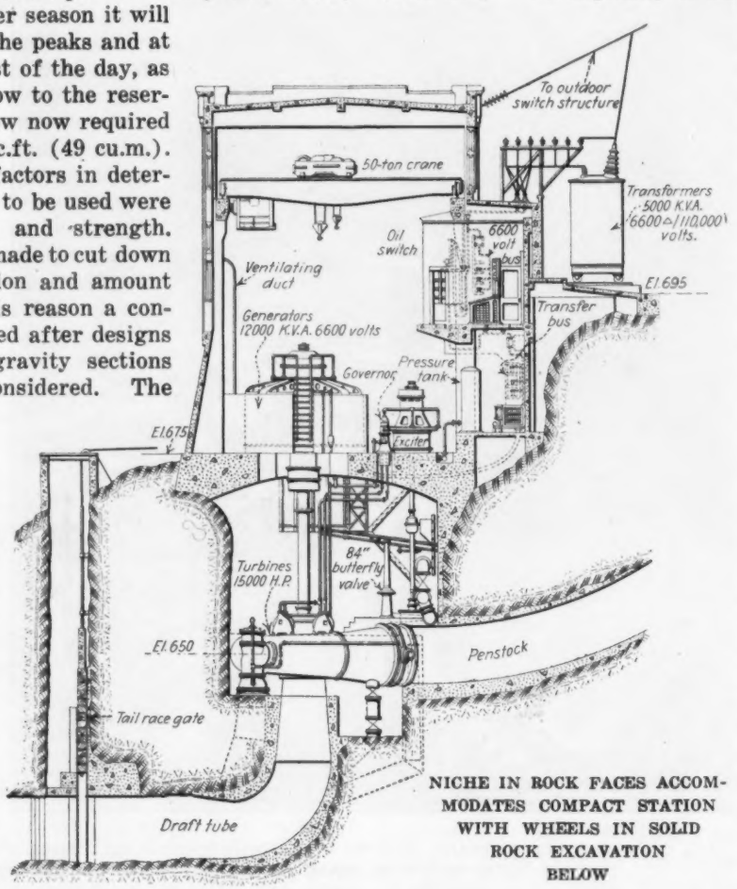
practically always in excess of 3,000 cu.ft. (84 cu.m.) per second with a maximum recorded flood in 1914 of 45,000 sec.ft. (1,260 cu.m.). The minimum flow of the stream at the present time, due to the Crane Valley and Huntington Lake storage, is approximately 500 sec.ft. (14 cu.m.). The future development of the Edison company will give a daily flow during the dry period of approximately 1,000 sec.ft. (28 cu.m.), which will mean that the plant can operate through the entire season with a 90 per cent daily load factor. Therefore the value of the Kerckhoff plant will increase with each additional development made on the San Joaquin River. During the high-water seasons the plant will be operated continuously at full load with 80 per cent daily load factor, and during the low-water season it will operate at full load on the peaks and at part load during the rest of the day, as necessitated by the inflow to the reservoir. The maximum flow now required by the plant is 1,750 sec.ft. (49 cu.m.).

The most important factors in determining the type of dam to be used were the elements of time and strength. Every effort had to be made to cut down the amount of excavation and amount of concrete, and for this reason a constant-angle dam was used after designs of multiple-arch and gravity sections had been carefully considered. The Kerckhoff constant-angle arch dam contains about one-half the yardage which would be required in a dam of gravity type using the same stresses, about 1,800 cu.yd. (1,375 cu.m.) less concrete and about 1,000 cu.yd. (764 cu.m.) less excavation than the best constant-radius arch dam which could be designed to fit the site. The arch dam also had the advantages over the gravity-section dam that there is never any danger of failure from sliding.

In order to handle floods without raising the maximum pond elevation (on account of power house No. 1 immediately upstream) and to gain the maximum head possible at all times of the year, fourteen 14-ft. x 20-ft. (4.2-m. x 6-m.) Tainter (radial) gates were installed on top of the dam. For operating these gates a specially designed motor-driven hoist is provided which runs on tracks along the top of the dam. One of the openings for Tainter gates has been equipped with a log chute extending out from the face of the dam, through which driftwood may pass without injury to the gates. The crest is constructed on a parabolic curve and a lip extends out over the downstream face to discharge the water free from the face and foot of the dam. The material from the excavation was cast downstream to retain a pool about 30 ft. (9 m.) deep between it and the dam into which the water from the crest falls, preventing erosion and vibration at the foot of the dam.

The capacity of the Tainter gates permits the discharge of 100,000 cu.ft. (2,800 cu.m.) per second, this being sufficient to take care of any floods. When the gates are closed the water will back up the river 2 miles (3.2 km.) to the tailrace of power house No. 1. At the bottom of the dam are three 72-in. (1.8-m.) rising-stem sluicegates which are operated by means of a geared gate stand.

No fish ladder is used in connection with this dam, because at low-water stages—a period of six months each year—all the water will be required for the generation of power, thus leaving the river dry from the dam to the power house, a distance of about 11 miles (17.6 km.). Consequently it has been decided to build a fish hatchery near the Crane Valley reservoir and transport the eggs from the lower waters of the San Joaquin.



NICHE IN ROCK FACES ACCOMMODATES COMPACT STATION WITH WHEELS IN SOLID ROCK EXCAVATION BELOW

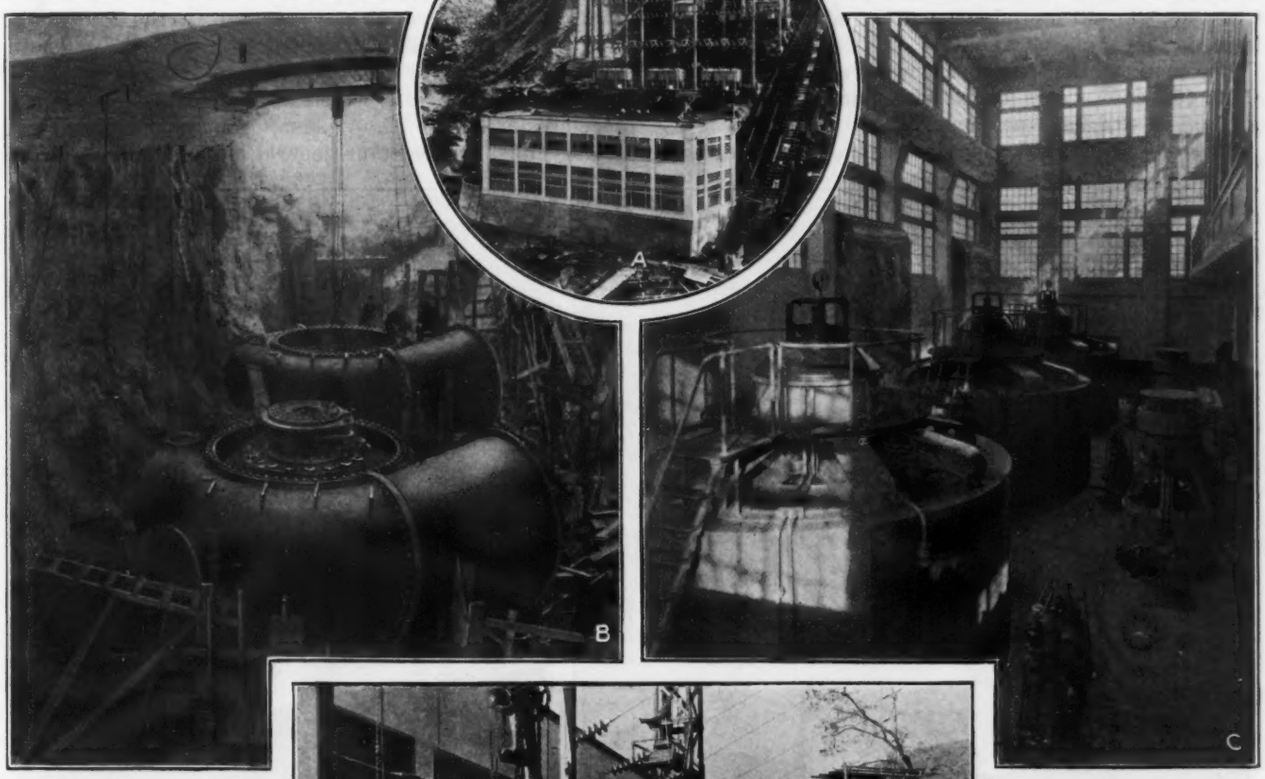
The first construction problem confronting the writer was the necessity for completing the dam before January, 1920, the beginning of the flood season. To reach the dam it was necessary to build 5 miles (8 km.) of road and an incline 2,700 ft. (900 m.) long, with a maximum grade of 92.5 per cent. If these had been completed first, sixty days would have elapsed before work on the dam could have begun. Therefore the diamond drill equipment, materials for camp supplies, etc., were packed on mules and hauled on sleds 7 miles (11.2 km.) over the hillside and down the steep mountain slope to the dam site, 1,100 ft. (330 m.) below. In this way the drill exploration for the foundations was completed, and a hundred men were put at work building a permanent camp and installing machinery at the dam site by June 1. The cofferdam diversion of the entire San Joaquin River through a flume was completed in less than sixty days. The excavation of 26,000 cu.yd. (23,700 cu.m.) of solid rock by steam shovel, and the entire construction of the dam, including 24,000 cu.yd. (21,900 cu.m.) of concrete, was completed Dec. 15, 1919, the first concrete being poured four months before. Meanwhile 17 (27 km.) miles of wagon road was built and steam shovels and other equipment were transported by trucks, so that with the completion of the dam before the winter flood the date of starting the Kerckhoff plant was fixed by the finishing of the tunnels.

Every effort was made to beat all existing records in tunnel progress. The correctness of the writer's belief in the superiority of the heading-and-bench method of tunneling with steam shovels mucking into electrically

hauled trains was fully demonstrated. The longest single tunnel to be completed was 8,400 ft. (2,560 m.) long, and this was driven from the two ends only in thirteen months' time.

The tunnel extends from Kerckhoff Lake, which is the storage reservoir formed by the construction of the dam, to a point near the power-house site where it connects with the steel penstock lines to the power house. It has an average driven cross-section of 320 sq.ft. (29.5 sq.m.) and a total length of 16,875 ft. (5,143 m.) and is all through a hard gray granite formation, requiring no timbering or lining. In order to drive the tunnel in record time five headings were used. The longest section was 8,400 ft. (2,560 m.), its length being due to the fact that it passes 2,000 ft. (609 m.) under a mountain peak where additional headings would have been uneconomical. In the "heading - and - bench method" used in driving the tunnel a bench about 14 ft. (4.2 m.) long and 7 ft. or 8 ft. (2.1 m. or 2.4 m.) from the roof was carried. A crew of four drillers and four chucktenders, operating four drills, drilled from thirty-five to forty holes from fifteen to twenty feet deep into the heading. The holes in the heading are drilled while the former shot is being mucked out. The mucking was done with "Marion 40" steam shovels operated with 100-lb. (7 kg.) air pressure furnished by a 4-in. (10-cm.) pipe line from the compressor house. The biggest factor in the progress made on these tunnels was the efficient operation of the steam shovels.

After the muck was cleaned up the bench crew drilled from twelve to sixteen holes horizontally into the bench. This required about four hours, after which the crew shot the holes. Loading and shooting usually occupied from midnight to 7 a.m., and by 8 a.m. the tunnel was clear of gas and a crew started cleaning up the track preparatory to moving the shovel ahead. At 10 a.m. the steam shovel started operating, and about noon the drilling crew was ready to go into the heading again. A complete round of 15 ft. to 18 ft. (4.5 m. to 5.4 m.) was made in each twenty-four-hour period. The highest rate of driving the tunnel was attained in May, when 453 ft. (138 m.) was excavated. The muck was hauled by 6-ton, 250-volt direct-current electric locomotives in trains of four cars each. In tunnel No. 2 "Exide Hy-Cap" storage batteries having 27.5 amp. rating on a five-hour basis were installed on General Electric locomotives. They were connected to float on the trolley, carrying approximately 265 volts.



FEATURES OF 50,000-HP. KERCKHOFF PLANT

A—At the top of the penstocks in background is a surge chamber excavated in solid rock. From the outdoor switching structure 110,000-volt lines run up mountain-side and then to Sanger, Corcoran and McKittrick. B—Waterwheels in pit below station. C—Three 14,200-kva. generators in area measuring 100 ft. x 36 ft. D—Transformers on concrete foundations back of station.

The batteries were always connected to the trolley except when handling cars within from 300 ft. to 600 ft. (90 m. to 180 m.) of the heading and on the dump, where no trolley was installed. This arrangement avoided the necessity of maintaining a trolley wire near the heading, where it would interfere with the mucking or shooting, or on the dump, where the track is not fixed. The method of floating the battery on a trolley permitted the use of a much smaller capacity in battery and did not require taking batteries out of service for charging. These batteries were operated five months continuously without discharging more than 50 per cent at any time and they were in first-class condition at the end of that time.

Locomotives thus equipped were able to haul four 6-yd. (5.4-cu.m.) cars loaded with muck on a level grade at 6 miles (9.6 km.) per hour.

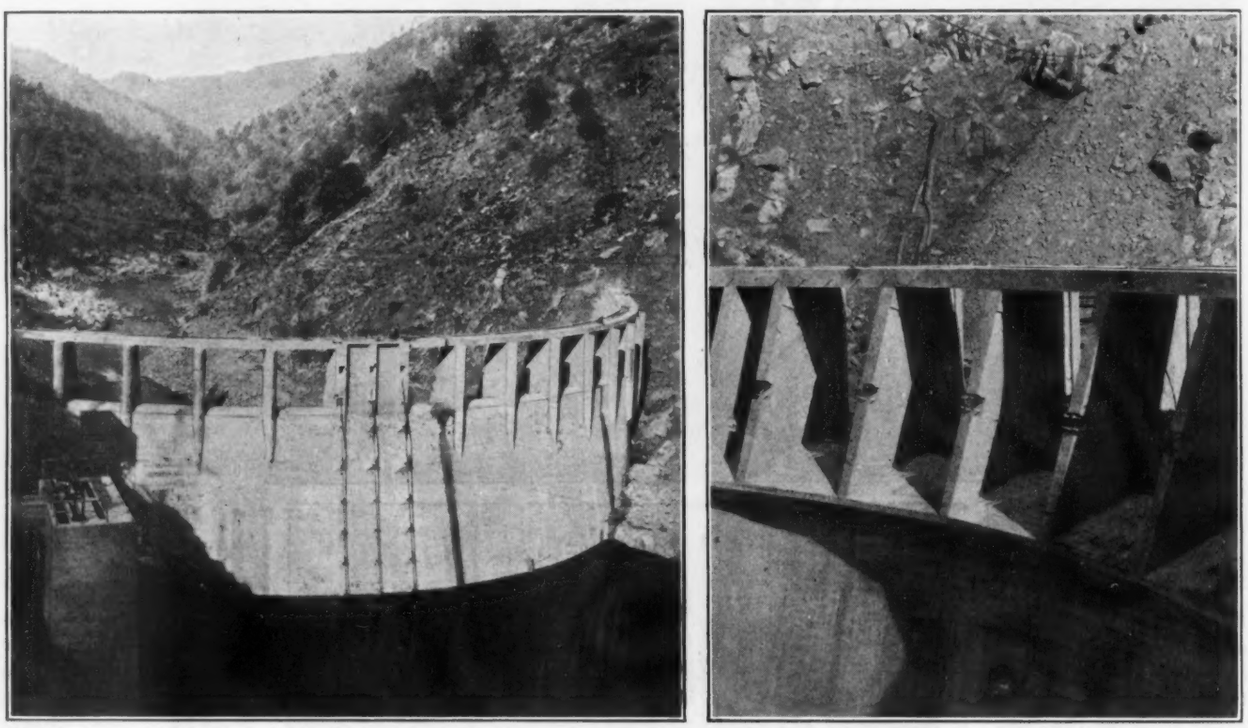
Records were also made in pipeline erection, three steel penstocks, 950 ft. (289.5 m.) long, 8 ft. (2.4 m.) in diameter at the portal and 7 ft. (2.1 m.) at the wheels, being installed in thirty-two days. Just outside the portal are three 8-ft. rising-stem gate valves, the valve and by-pass being operated electrically from the power-house switchboard and so interlocked electrically as to require operation in the proper sequence. Ahead of each waterwheel is an 84-in. (2.1-m.) butterfly valve, also electrically controlled from the switchboard and designed to close against the full penstock pressure in the event of failure of a waterwheel casing. Air-relief valves are provided on top of each pipe line to permit the entrance of air when the penstock lines are emptied, to prevent their collapsing. No standpipes are used, but a surge chamber has been cut out of the solid granite a short distance back from the tunnel portal. This chamber is 40 ft. (12 m.) in diameter at the roof of the tunnel and tapers to 17 ft. (5.1 m.) in diameter at the spillway elevation, which is approximately 20 ft. (6 m.) above the top of the Tainter gates at the Kerckhoff dam.

The factors determining the dimensions of the surge chamber were twofold:

(1) To discharge water flowing in the tunnel when load is rejected by the units in the plant, without seriously increasing the surge in the penstocks, the spillway being 5 ft. (1.5 m.) above the top of the Tainter gates in the dam.

(2) To provide water for the wheels when the plant load is suddenly increased while the water in the tunnel increases its velocity to take care of the increased load demand.

Completing a 50,000-hp. hydro-electric plant in fifteen months under the conditions prevailing at the time would not have been possible had it not been for the wonderful support given by the management of the company, which comprises W. G. Kerckhoff, president; A. C. Balch, vice-president; A. G. Wishon, general manager; A. Emory Wishon, assistant general manager; I. W. Alexander, stock sales manager, and D. P. Mason, purchasing agent.



UPSTREAM FACE OF KERCKHOFF DAM BEFORE WATER WAS IMPOUNDED AND LIP ON DOWNSTREAM SIDE OF SPILLWAY

It would naturally be thought that such records for speed could be made possible only by enormous additional expenditures, but actual records prove this construction the cheapest of its kind completed since 1913.

Of the organization the following men deserve special credit for the part they performed: Henry R. Stevens, superintendent of construction; L. L. Ellis, assistant superintendent; Dick Pease, master mechanic; J. D. McDougal, general foreman of construction; B. F. Jakobsen, designing engineer; H. K. Fox, resident engineer at the power house; L. T. Jackson, resident engineer at the Kerckhoff dam; R. C. Starrett, resident engineer of tunnels; H. P. Van den Bossche, mechanical engineer, and A. H. Coutch, office manager.

The successful tunnel contractors were D. D. DeLuca and W. A. Whitmire, both of whom deserve special credit.

Features of the station itself will be presented in a later issue.

Economy Through Plant Co-ordination

Superpower Load-Center Analysis Shows Existence of Opportunity in This Direction — Data of Local Survey on Worcester (Mass.) Load Center — Striking Range of Plant Sizes and Unit Ratings

DATA showing results of the local power survey for the so-called Worcester load center were presented recently in Worcester, Mass., by Henry Flood, Jr., engineer-secretary Superpower Survey, New York, speaking before the Worcester Section of the American Institute of Electrical Engineers. He pointed out that through the interconnection plan which the Survey is studying opportunities for the more efficient production and distribution of electrical energy may be realized. Mr. Flood brought out the striking range of plant sizes and unit ratings in the Worcester load center and showed that for the year 1919 there was an excess of effective steam-plant capacity in that district of only 10.8 per cent above the aggregate peaks of that year in the steam plants. The average coal consumption was 2.65 lb. per kilowatt-hour and 125,000,000 kw.-hr. was generated in the steam stations. The total generated output of the district during the year was 344,000,000 kw.-hr., of which the central stations produced 94 per cent. The estimated increase in output of the central stations of the district, including the New England Power Company, is more than 125 per cent comparing 1920 with 1919. Sixty-three generating units of under 2,000 kva. in rating and eighteen plants under 1,000 kva. were in service in the district in 1919. By the Superpower plan, Mr. Flood declared, many small and relatively inefficient units will be shut down to insure the greater efficiency of energy supply from large installations.

SPECIFIC DATA ON EXISTING CONDITIONS IN WORCESTER LOAD CENTER

Aggregate annual peak classified as to cycles:

	Kw.	Percentage of Total
60 cycles	86,810	88
25 cycles	11,000	11
Miscellaneous	920	1
Total	98,730	

1919 output:

	Kw.-Hr.	Percentage of Total
60 cycles	286,370,000	83.5
25 cycles	55,670,000	16.0
Miscellaneous	2,090,000	0.5
Total	344,130,000	

Load factor, 39.7 per cent.

Generated output 1910-1919*:

Year	Kw.-Hr.	Year	Kw.-Hr.
1910	88,310,000	1915	227,000,000
1911	105,070,000	1916	270,660,000
1912	124,640,000	1917	300,050,000
1913	155,610,000	1918	308,420,000
1914	175,660,000	1919	344,130,000

Aggregate kw. peak load 1910 to 1991:

Year	Kw.	Year	Kw.
1910	28,800	1915	74,200
1911	30,700	1916	84,100
1912	38,400	1917	87,700
1913	50,000	1918	88,500
1914	53,500	1919	98,500

* Increased 290 per cent in nine years, or 16.5 per cent annually compounded.

Load factor, 35 per cent.

Estimated future growth of energy†:

Out of a total output of 344,000,000 kw.-hr. generated in 1919, central-station companies representing 323,000,000 kw.-hr., or 94 per cent of the total, have given estimates as to the future growth of load, as follows:

Year	Kw.-Hr.	Year	Kw.-Hr.
1919	323,000,000	1923	496,000,000
1920	346,000,000	1924	543,000,000
1921	402,000,000	1925	590,000,000
1922	449,000,000	1930	789,000,000

In addition to the above, street-car companies generated 18,500,000 kw.-hr. in 1919. It may be assumed, approximately, that these companies will have an increase of 9,000,000 kw.-hr. in the next ten years, or a total of approximately 28,000,000 kw.-hr., which added to the above would equal 817,000,000 kw.-hr.

Daily diversity (Nov. 25, 1919):

	Kw.
Aggregate non-coincident peak	86,100
Maximum coincident peak	84,860
Diversity	1,240

Percentage of diversity, 1.5. Kilowatt-hours generated, 1,136,946. Daily load-factor, 56 per cent.

† An increase of 125 per cent in ten years, or 9 per cent annually, compounded, excluding street-railway companies, and 140 per cent in ten years, or 10 per cent annually, compounded, inclusive of these companies.

Plant capacity:

Hydro-electric (45 per cent of total):

	Kw.
60 cycles	61,580
25 cycles	8,600
Miscellaneous	350
Total	70,530

Steam (55 per cent of total):

	Kw.
60 cycles	76,825
25 cycles	10,000
Miscellaneous	575
Total	87,400
Grand total	157,930

Range of power-plant size:

	No. of Plants
Rated at 50,000 kw	1
Rated at 20,000 kw. or over	3
Rated at 10,000 kw. or over	5
Rated at 5,000 kw. or over	9
Rated at 1,000 kw. or over	13
Rated at 500 kw. or over	18
Total	49

Range of size of generating units:

	No. of Units
Rated at 20,000 kva	2
Rated at 10,000 kva. or over	3
Rated at 5,000 kva. or over	11
Rated at 2,000 kva. or over	34
Rated at 500 kva. or over	63

	Kw.
Generating capacity of steam-electric plants	87,400
Aggregate of steam-station peak loads	56,580
Excess steam generating capacity (54.5 per cent of peak)	30,820
Effective steam generating capacity	62,700
Aggregate of 1919 steam-station peaks	56,580
Excess effective capacity (10.8 per cent of peak)	6,120

	Tons
Coal consumed in 1919 in steam plants	167,000
Corresponding kw.-hr. generated	125,000,000
Corresponding kw.-hr. capacity	87,400
Tons of coal per kw.-year, at 2.65 lb. per kw.-hr.	1.9
Average B.t.u. per kw.-hr.	36,000

Use of power:

Power generated or produced by the companies allocated to these load centers sold their energy for the following purposes:

	Kw.-Hr.	Percentage of Total
Light	25,100,000	9
Power	204,600,000	73
Railways	48,000,000	17
Total	277,700,000	

Power production cost:

Fuel	$1,150,000.00
Maintenance	102,000.00
Other operating costs	480,000.00
Total	$1,732,000.00

Included in the above is $197,300.00 that represents operating costs of hydro-electric plants. The total operating cost of steam plants is equal to $1,534,700.00, or 1.22 cents per kw.-hr., exclusive of overhead charges, administration, etc.

Small Portable Photometer Shows Accuracy

May Be Carried in a Brief Case, but Has Accuracy Substantially Equal to Larger Types—Suitable for Measurements of Candlepower and Foot-Candles

BY DAVIS TUCK
Electrical Engineer Holophane Company

A NEW form of light meter capable of making photometric measurements of the same order of accuracy as the larger portable illuminometers has recently been designed by the writer that will measure candlepower, millilamberts and foot-candles to a reasonable degree of accuracy and which is truly portable since it may be carried in a brief case or traveling bag.

The scientific principle involved is not new but is the same as that used in both the Sharp-Millar and the Macbeth instruments. The greatly reduced size has been made possible by careful design to this end. The principle involved is that of the inverse-square law. The standardized electric lamp is moved with respect to a ground-glass plate which is the variable-standard brightness against which the unknown brightness is matched.

ILLUMINATION (FOOT-CANDLES) MEASURED WITH THREE PHOTOMETERS

Station	Macbeth	Light Meter	Foot-Candle Meter
1	14.8	15.0	16
2	12.1	12.0	13
3	12.2	12.4	14
4	12.0	11.8	10
5	13.5	13.6	11
6	14.2	14.2	15.5
7	14.7	15.0	17
8	14.9	15.0	15
9	14.7	14.7	12
Average	13.7	13.7	13.7

The over-all length is 12 in. (30 cm.), the maximum diameter is 2¼ in. (5.4 cm.), and the weight complete with the battery is 1 lb. 9 oz. (0.7 kg.).

The battery consists of three dry cells each 2¼ in. (5.7 cm.) long and 1¼ in. (3.2 cm.) in diameter, being one of the standard flashlight batteries. One of the larger forms of flashlight batteries has been used so as to obtain a comparatively long burning period of the lamp before the voltage drop is noticeable.

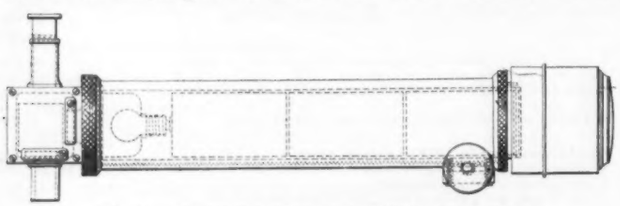


FIG. 1—CROSS-SECTION SHOWING ASSEMBLY OF THE LIGHT METER

A lamp was selected which takes a small current from the battery (0.1 amp.), and it is burned at a low efficiency. This has the most desired effect of placing only a small drain on the battery and of maintaining the lamp at its standardized operating characteristics over a relatively long period.

The rheostat is circular in form and is arranged with a sliding contact so that resistance is cut in or out by turning the ammeter about its axis. When all of the resistance is cut in the sliding contact rides on an insulated plate that functions as a switch. In this way the lamp is at all times protected from having too high a voltage suddenly placed across it by an unskilled operator or because of absent-mindedness on the part of the skilled operator.

The ammeter is of the D'Arsonval type, and the shunt is made to give virtually full-scale reading when the lamp is operated at the standardized current. The glass over the face of the ammeter is fitted in the same way as a watch crystal, so that the scale on the ammeter can be easily accessible for marking the calibration point. The method of assembly of the rheostat switch and ammeter makes for compactness and lightness and makes wired or soldered connections unnecessary. Fig. 1 shows the assembly of these parts.

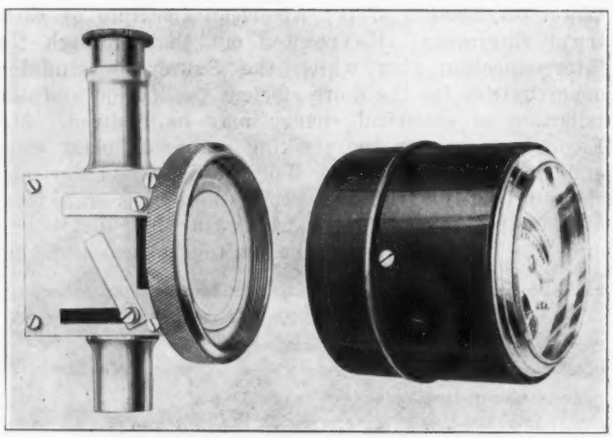


FIG. 2—PHOTOMETRIC ELEMENT AND AMMETER WHICH CONSTITUTE THE ENDS OF THE PHOTOMETER

The tube which carries the battery and rheostat assembly also carries the lamp housing and is moved back and forth by means of a rack and pinion when measurements are being made. The lamp is placed in a half sphere with a piece of ground blue glass on one side over the opening. This construction has the advantage of avoiding the inequalities of illumination due to various lamp orientations and places the lamp in a dust-tight protected chamber. The ground blue-glass plate is a secondary light source, and its distance from the piece of milk glass in the light meter head determines the calibration constant of the instrument. Small variations in lamp dimensions therefore do not affect the scale calibration.

Three scales are provided, showing candlepower, millilamberts and foot-candles respectively. The scales are engraved on the sliding tube. The photometric device is a modified Lummer-Brodhun cube. The telescope has an adjustable focus.

The range of the foot-candle scale is from 0.5 foot-candle to 15 foot-candles. Provision is made for inserting neutral-tint screens either on the test or comparison side of the cube. The screens used have a transmission factor of 10 and 1 per cent respectively, so that the range is increased to 0.005-1,500 foot-candles.

A series of foot-candle measurements was recently made in a factory using a Macbeth illuminometer, the light meter and a foot-candle meter. The accompanying table shows how these readings compared.

It will be noted that the average foot-candle value measured by the three instruments were identical.

American Institute of Electrical Engineers

Midwinter Convention

Features of Papers Presented in New York, Feb. 16 to 18 Inclusive, on Limitations of Oil Switches, Permissible Cable Temperatures, Measurements and Miscellaneous Subjects—Need of Rating Circuit-Breakers on Basis of More Reclosures—Present Evidence Does Not Justify Raising Cable Temperatures

THE maximum temperature at which paper-insulated cable can be operated safely was the chief subject of discussion at the midwinter convention of the American Institute of Electrical Engineers, held in New York on Feb. 16 to 18 inclusive. Six papers were presented on this subject. Present-day limitations of oil circuit breakers ranked close to cable temperatures in importance, although only two papers on the topic were presented. Of the remaining subjects that came under consideration, regulation of frequency for metering purposes, short-circuit currents of induction machines, heat flow in armature coils and wave transmission were particularly interesting. With the exception of papers on flutter of composited telephone lines and telephone problems of railroads, and one on cable temperatures, presented quite fully on page 413 of the Feb. 19 issue, abstracts of all the papers follow. These abstracts are under the headings of "Oil-Switch Limitations," "Safe Cable Temperatures," "Meters and Measurements" and "Miscellaneous."

Recent experience of some of the large operating companies has indicated that the temperature limit of 85 deg. C. for paper insulation in low-tension (around 220-volt) cables may be too conservative. The present limits have been established in connection with investigations of insulation for high-tension cables and because of results showing that paper suffers mechanical deterioration when subjected to a temperature of about 90 deg. C. There is evidence that paper may suffer some deterioration and still be sufficiently good for low-tension service and will even stand withdrawal of the cable from ducts and reinstallation. The question is whether cables subjected to the usual load cycles may not operate at least a few hours a day above 85 deg. C. Data are furnished by cable manufacturers and users, and several suggestions are offered regarding possible temperature limits for short-time heavy loads.

The consensus of opinion, however, appeared to favor the present conservative temperature rating for paper-insulated cables. Even though higher temperatures may be safe, most of those who discussed the matter believed that the operating engineer should decide whether or not he was justified in operating at higher temperatures in his own particular system by sound engineering and economic considerations.

In one of the papers regarding oil switches some of the operating requirements and limitations were outlined, and recommendations were made by the subcommittee on this subject. These are particularly important because they represent the attitude of operating men as a result of actual experience with the apparatus. The comments refer chiefly to voltage-test requirements, ventilation of switch cells, short-circuit current-carrying capacity and method of rating oil circuit breakers.

Observations made in conducting high-current tests on high-tension circuit breakers were presented in another paper. This investigation showed the need of strengthening brush contacts and supports and of strong locks on disconnecting switches and brought out some requirements of instrument transformers. Aside from the information they gave, these tests were especially interesting because of the manner in which they were conducted.

The principal facts brought out in the discussion of the convention papers are included in this report.

Oil-Switch Limitations

Recommendations Based on Operating Viewpoint

Voltage Test Requirements Should Be More Severe—Ventilation—Short-Circuit Current-Carrying Capacity Advisable

IN ORDER to summarize the present-day indefinite operating requirements and limitations of oil circuit breakers, the A. I. E. E. (protective-devices committee), N. E. L. A. (apparatus committee) and Electric Power Club (power-switchboard and oil-circuit-breaker section) co-operated in sending out a joint questionnaire for oil-circuit-breaker data to the larger operating companies. Some of the observations and recommendations of the A. I. E. E. sub-committee on oil circuit breakers and switches were presented by its chairman, H. R. Woodrow of Stone & Webster, Inc.

There have been some failures due to the inability of the oil circuit breaker to withstand voltages encountered under operating conditions, therefore it would seem that the present test requirements, as specified by the A. I. E. E. standards, of two and one-quarter times operating voltage plus 2,000 volts may not be severe enough for the larger moderate-voltage system. Furthermore, these tests are usually made under clean, dry conditions, whereas the circuit breaker is subjected to abnormal conditions at the time of its operation. With this in view, the committee suggests that oil-circuit-breaker standard potential tests be investigated with an idea of increasing this test value. These tests should be made between all live parts to ground and between phases under minimum clearance conditions.

In order to reduce the maximum temperature and to

prevent accumulation of explosive mixtures in cell compartments, which has given some trouble, the recommendation is also made that careful consideration be given to ventilation of compartments, avoiding at the same time any method which would allow gas from one compartment to enter an adjacent cell. One company has found it desirable to carry the ventilation from each tank to the outside of the building. It would also be a great help if the contacts were made for greater ease and permanency of adjustment.

Since trouble has been experienced by some of the larger operating companies through the failure of oil circuit breakers to carry heavy short-circuit currents during the period required to open the circuit, it is recommended that all oil circuit breakers shall have a short-circuit current rating for periods of say both one and five seconds which should be at least equal to the interrupting capacity and in most cases two to three times this value. The manufacturers should test each line of their breakers or make periodic tests of breakers as they are brought through the factory.

The present-day practice of rating oil circuit breakers to interrupt a given root-mean-square current at normal voltage two times at a two-minute interval, the circuit breaker then to be in a condition to be closed and carry the rated current until it is practicable to inspect and make necessary adjustments, is not, according to Mr. Woodrow, in accord with operating requirements as reported in the replies to the questionnaire. For example, in some cases the operators find that after a breaker has opened automatically two, three, four and as high as five times, reclosing the breaker will restore service. Therefore the manufacturer should as soon as possible give a rating on oil circuit breakers on the single-shot basis and proportion these ratings on the reclosing basis. A breaker rated at a certain value on the single-shot basis would then be rated at a somewhat lower value on a two-shot basis and at other values below this on a basis of three shots, four shots, etc.

There is considerable difference of opinion as to what should be considered satisfactory operation of an oil circuit breaker, but it is suggested that it means the rupturing of current within a definite time limit after the energizing of the trip coil, which time allowance could be relied upon for selective operation of relays on the system, without throwing burning oil outside of the tank or causing permanent deformation of tanks or any of the current-carrying parts.

It is suggested that the rating be made with only the manufacturer's factor of safety to cover any inequalities of materials and manufacturing processes. The purchaser of an oil circuit breaker could then rely on a given rating at all times and should not count on more.

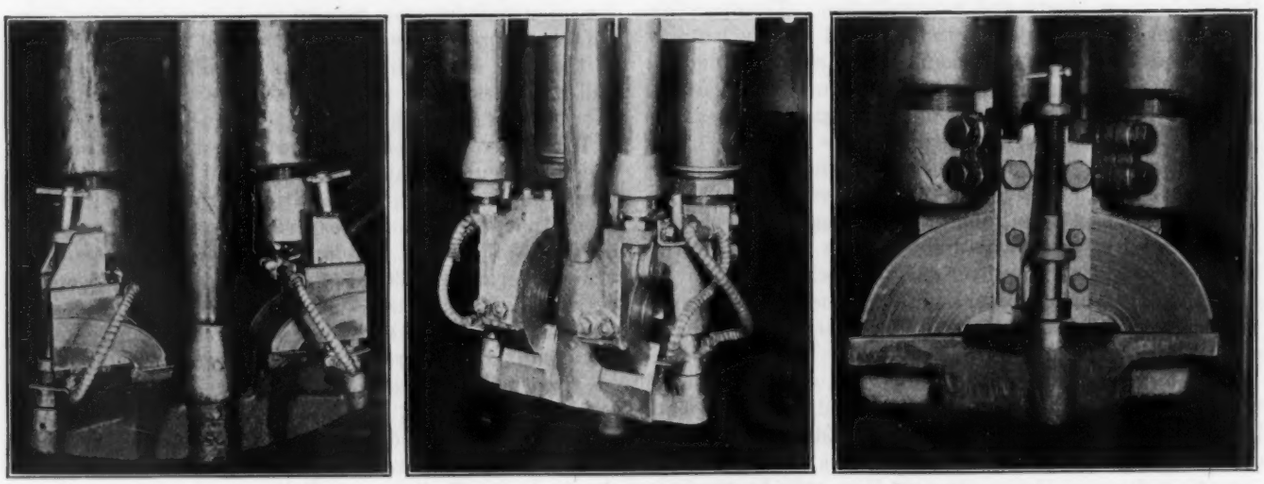
Tests made by one of the operating companies showed that reactance imposed a heavier duty on the oil circuit breaker than resistance for the same value of current. On the other hand, an increase in the speed of operation of some of the older type of breakers has made an improvement in the interrupting capacity. In 90 per cent of the cases reported venting the tanks has been found desirable.

It would be advantageous if some standards could be adopted by the oil-circuit-breaker manufacturers so as to reduce the number of types of oil required.

High Current Tests on Switchgear

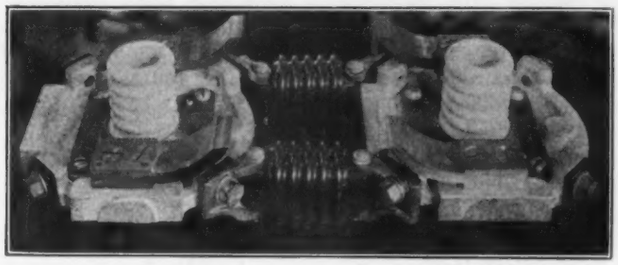
Strength of Brush Contacts and Supports —Need of Strong Locks for "Disconnects" —Requirements of Instrument Transformers

A SERIES of tests on oil circuit breakers and disconnecting switches to determine the ability of brush contacts and supports to withstand currents of the order of 100,000 amp. was described by Philip Torchio, chief electrical engineer New York Edsion Company. For the first time, he said, a synchronized motion-picture machine and an oscillograph were coupled to reproduce the coincident actions of the apparatus tested and the variations of voltage and current in the circuit. The tests proved that practically all the circuit breakers then on the market had the brush contact placed in the wrong position, so that when the current flowed the resultant mechanical force acted in a direction opposed to the brush pressure, thus tending to open the contact at this point, whereas if the position of the contact brushes had been reversed, the mechanical force due to this current would have been exerted in the same direction as the brush pressure, thereby tending to improve the contact. In addition to the force exerted at the contacts, it was found that the repelling force between contact supports was of such magnitude as to distort, and in some cases permanently displace, these parts.



IMPROVEMENTS IN TYPES CO-2, C-1 AND O-2 CIRCUIT BREAKERS
A—Quarter elliptic inverted brush contact for 1,200-amp. breaker. B—Circular inverted brush which increases contact pressure under load conditions. C—Half elliptic brush for 4,000-amp. breaker

In all these tests the circuit breakers were locked in the closed position. The arcing, therefore, was caused by the opening of the main and arcing contacts due to the mechanical force resulting from the high current. This phenomenon occurs in practice before the operating mechanism has had sufficient time to perform its function in opening under short circuit.



IMPROVED TYPE FH-3 OIL CIRCUIT BREAKER EMBODIES INVERTED CONTACT BRUSH AND TIE INSULATORS

On the basis of the results obtained, the manufacturers have revised the design of their circuit breakers so as to eliminate the trouble due to contact separation and displacements. The method of conducting the tests and reproductions of the oscillogram records are presented in the complete paper.

Switch Ratings Needed on One-Shot to Five-Shot Basis

THE severity of modern service conditions and cost of existing oil switches may necessitate radical changes in their design, according to the opinion expressed by Peter Junkersfeld. E. P. Peck and N. L. Pollard supported the subcommittee of the protective devices committee in its recommendation of rating oil switches on the one, two, three and even the five-shot basis, because it is usually necessary to reclose breakers several times after an interruption in order to restore service. Dr. E. E. F. Creighton agreed with Mr. Junkersfeld that oil switches may require radical change in design to meet present severe operating conditions, and went so far as to say that they might undoubtedly have to be designed to open short circuits as many as a dozen times in succession without being inspected.

A rather novel fuse construction was described by H. E. Trent in which the fuse wire is threaded through cement cylinders which are slightly separated so that the wire is exposed between segments. He referred to the advantages of this construction and to some tests conducted thereon. In a written discussion N. J. Conrad contended that Mr. Torchio's tests were not inclusive enough to prove that there are no potential fuses on the market which will successfully rupture a short circuit without resistance in series. He maintained that tests had been conducted on the Commonwealth Edison system which show the effectiveness of one style of carbon-tetrachloride fuse.

Replying to the foregoing observations Mr. Torchio said that his tests of potential fuses and remarks regarding them had not covered the carbon-tetrachloride fuse to which Mr. Conrad referred because he considered them more in the class of circuit breakers. However, he still maintains that potential fuses will operate better if used in series with a resister to limit the current. The tendency among users is to obtain the cheapest circuit breakers rather than to plan for future requirements and get switches that will meet them. The prevailing practice should be reversed, Mr. Torchio warned. Mr. Woodrow emphasized the need of opinions from operating men on circuit-breaker requirements if manufacturers are to be expected to furnish desirable equipment.

Safe Cable Temperatures

Conservatism Urged in Cable Rating

Freedom from Trouble Due to Overloading in Boston System Is Held to Justify Present Temperature Limits

ALTHOUGH a higher temperature is allowed in rotating equipment than in underground cables, the difference that exists is not so unjustified as may appear, L. L. Elden, electrical engineer Edison Electric Illuminating Company, held, because machinery is usually more readily observed and controlled. Besides, cable insulation suffers from aging. In fact, Mr. Elden's paper brought out that cables have been examined after being in stock for several years and it has been found that the insulation was too brittle to withstand the mechanical stresses of installation. Less rigid specifications for low-tension cables may be possible at the cost of more rapid depreciation, but the real question for cable users to decide is the rate of depreciation which they are willing to accept as the result of operating the cable at higher temperatures.

If, as seems quite likely, the existing temperature limit of 85 deg. C. may be safely exceeded for short periods without injury to paper insulation, it would seem preferable to apply an overload rating to low-tension cables which may be taken advantage of as occasion requires, rather than to operate such cables on a load-factor basis. The objection to the latter method lies in its impracticability of application to the operation of any system of distribution. In actual service each feeder operates on a load factor of its own which may or may not coincide with the system load factor. Further, load factor makes no distinction between seasonal loadings, a most important factor in the operation of a cable system.

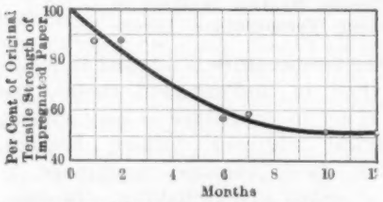
In the operation of the Boston company's 230-volt direct-current system during the past eleven years careful records of direct-current feeder loads have been maintained, which show that more than 800 amp. has been carried on 1,000,000-circ.mil concentric and single-conductor cables 75,800 hours. Of these instances 70 per cent have occurred in the winter months, clearly indicating the seasonal load characteristics of the system which afford such favorable conditions for operating cables at relatively high load values during the period of lowest temperature.

In eighteen years of use of single-conductor and concentric low-tension feeder cables there is no record of a failure of these cables due to loading conditions. While this may be considered evidence of too great conservatism in the use of the plant, it is the opinion of Mr. Elden that it is justified by freedom from interruptions of service. Therefore it is inadvisable to depart from the present practice to approve a higher degree of loading, which must invariably develop new troubles.

Risks in Raising Cable Temperatures

Mechanical Properties of Paper Insulation Are Destroyed Rapidly at 100 Deg. C. — Caution Advocated in Raising Temperature Limits

WHILE the experience of central-station men in carrying increased loads during the war indicates that low-voltage cables may be operated at higher temperatures than were considered safe in the past, W. A. Del Mar, chief engineer Habirshaw Electric Cable Company, did not consider that there is sufficient evidence to justify the manufacturers in agreeing to share the risks resulting from operation at or beyond the limit of temperature allowed heretofore. Five preliminary problems, he asserted in his paper, must be solved before the main one of determining the maximum safe operating temperature of insulating materials, such as impregnated paper. They are as follows:



WEAKENING OF IMPREGNATED PAPER AT 85-90 DEG. C.

1. What is the criterion of quality of paper insulation by which to determine whether it is satisfactory for service?

2. What is the effect of the continued application of various degrees of heat, expressed in terms of the criterion selected?

3. Will intermittent heat have the same effect as continuous heat, provided that the aggregate time of exposure and the temperature are the same in both cases?

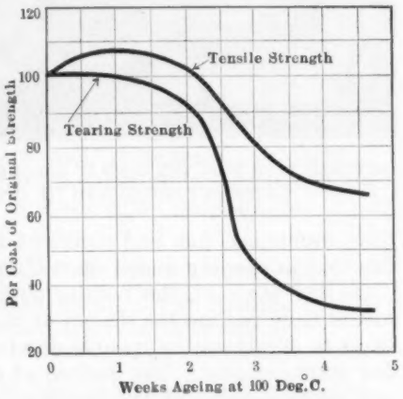
4. If the above questions should be satisfactorily answered, what form of rule should be adopted so as to make the best economic use of the information thus obtained?

5. If a rational rule for the maximum permissible temperature of paper insulation should be developed, how can the hottest-spot temperature of a cable in a duct be measured in order to insure that the cable is working within the rule?

In the opinion of Mr. Del Mar the tearing test is an excellent criterion for paper insulations. In this test the sample is subjected to increasing tearing stresses until the length of the tear has reached one centimeter. The reason for letting the paper tear a definite amount, rather than observing the force at which the paper begins to tear, is that paper varies in thickness and condition from place to place and the initial tear would only represent the strength at a spot and would not be a measure of the average quality.

When impregnated the tearing strength of manila rope paper is usually less than when unimpregnated, depending upon the nature of the impregnating compound, the temperature and duration of the process of impregnation and the amount of the compound retained upon cooling. Manila-rope paper usually contains from 5 to 10 per cent of moisture. Tests indicate that an increase of moisture increases the tearing strength up to about 10 per cent and decreases it above that point. Statements of tearing strength are therefore not complete unless the moisture content is specified. Tests made on rolls of paper immersed in petrolatum-resin compound maintained between 85 and 90 deg. C for a year indicate that at the end of the year paper loses about half the tensile strength it possesses just after impregnation, although it is in good enough condition even then for new low-voltage cables. It is probable that the tearing strength would have been even more reduced.

Among other tests which have been made some conducted with sealed lead-sheathed cables placed in an electric oven maintained carefully at a temperature of 100 deg. C. indicate that after the fourth week the paper becomes so brittle that it will crack when folded. The mechanical strength of paper-insulated cables is almost entirely destroyed by continuous exposure to a temperature of 100 deg. C. for three or four weeks. In Mr. Del Mar's opinion, cables in the same condition as these samples may operate satisfactorily, but the risk of continuing their service in this condition is obviously greater than with the insulation in good mechanical condition. About the same effect would be produced if cable were heated for three hours every day for eight months. Such a test is under way and when it is completed will show whether paper recovers any of its strength during the low-temperature intervals between intermittent heating.



PAPER LOSES STRENGTH RAPIDLY AT 100 DEG. C.

Cables Withstood Excessive Temperatures in Service

Temperature Surveys in Chicago Reveal Paper Cables Operating Intermittently [Near 180 Deg. C. in Crowded Duct Lines]

THE best that can be done at present to determine the maximum cable temperature that can be allowed, said D. W. Roper, superintendent of street department Commonwealth Edison Company, in his paper, is to obtain average curves showing the number of hours per year that temperatures near the maximum are maintained. From an examination of the insulation of cables corresponding to a number of such curves it should be possible to establish: (1) a lower limit at which the insulation will not be injured, even when the temperature is maintained for long periods of time, and (2) an upper limit above which insulation will be injured if such temperature is maintained for any considerable time. From the information so far obtained in Chicago, the best that can be done is to place the lower limit at about 110 deg. C. and the upper limit at about 180 deg. C.

With 1,000,000-circ.mil two-conductor concentric paper-insulated cables which were loaded more heavily than had been customary throughout the day and in which three pressure wires were laid with the outer conductors, careful measurements showed that the outer copper operated at slightly over 100 deg. C. in one case. The inner conductor was probably 8 deg. or 10 deg. hotter. In another case the load was about 10 per

cent heavier. While no measurements were taken in the latter case, the cable was removed after several years' service and reinstalled when examination showed the insulation to be in good condition.

The results obtained from temperature surveys indicate that the maximum copper temperature on the low-tension feeder cables in large and crowded conduits immediately adjacent to substations is generally higher than 105 deg. C. In a number of locations the temperatures considerably exceed this figure for several hours per day during five days of each week in winter months. In one or two cases where twenty-duct or twenty-four-duct conduits leave the substations with nearly all ducts occupied with loaded feeder cables, vacant-duct temperatures have attained approximately 100 deg. C. for short periods on Friday afternoons during two or three weeks in December. According to the Atkinson method, such idle duct temperatures indicate a maximum temperature approaching 200 deg. C. on the inner conductor of a concentric cable.

Upon removal of a section of one such cable a hole about 1 in. (2.5 cm.) in diameter was found in the lead sheath about 8 in. (20 cm.) from the mouth of the duct, apparently due to the catching on the edge of the duct when the cable was installed. In the immediate vicinity of the hole, the paper insulation was quite black and so brittle that it broke readily when handled. At another point 30 ft. (10 m.) away the paper insulation, while slightly darkened, was still well filled with compound and pliable, although it had lost some strength, indicating that the deterioration in insulation was not caused by heat alone but by its combination with the presence of air and possibly moisture.

Cable Samples Tested at 110 Deg. C.

Cable Considered Satisfactory for Low-Voltage Service Even After Continuous Heating for Ninety Days at 110 Deg. C.

RESULTS of a series of tests to determine the effect of various temperatures on the tearing strength of paper insulation were discussed in the paper of Wallace S. Clark, engineer of wires and cables General Electric Company. He gave data showing the usefulness of the tearing test and results of high temperature runs. It has been found that the ratio of tearing strength to the average tensile strength in sample A, cable not heated after manufacture, is 0.72; in sample D, heated ninety days at 100 deg., 0.57, and in sample G, heated ninety days at 110 deg., 0.64. The test showed that the tensile strength of the paper deteriorates less rapidly than its resistance of tearing. The higher rate of deterioration at 110 deg. C. is clear and is well marked by comparing the results from sample D, ninety-day bake at 100 deg., with sample E, thirty-day bake at 110 deg., the deterioration in thirty days at 110 deg. being virtually equal to deterioration in ninety days at 100 deg. From these results it was deduced that deterioration at 70 deg. C. is negligible; at 100 deg. it is marked in ninety days; at 110 deg. it is marked in thirty days, applying to the particular quality of paper and impregnating compound which were under test.

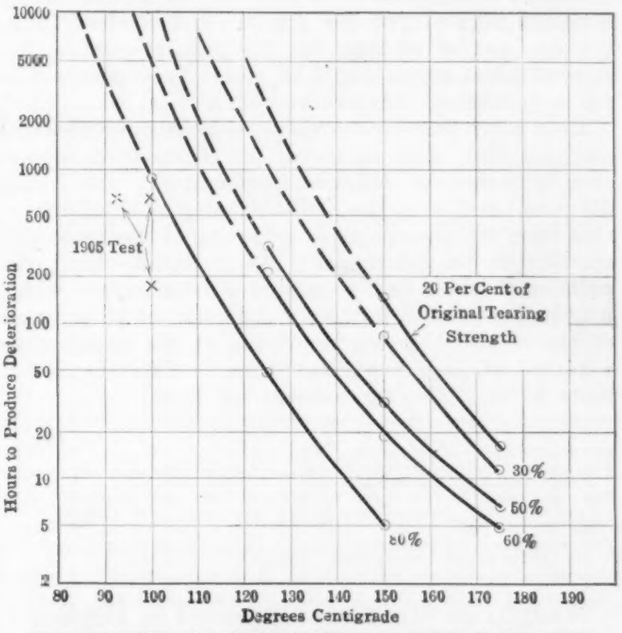
From an examination of the cable and paper taken from sample G, Mr. Clark believed that this cable would be perfectly safe for operation at low voltages. He also believed that cables so treated could have been withdrawn from conduit and reinstalled.

Paper Insulation Rapidly Deteriorates Above 85 Deg. C.

How Mechanical Properties of Cables Are Affected by High Temperatures—Recommendations Regarding Intermittent Overloads

THE principal effect of high temperatures on low-voltage cable insulations, according to the paper of H. W. Fisher and R. W. Atkinson, Standard Underground Cable Company, is the reduction of mechanical strength. Hence changes in the mechanical structure of insulations constitute a good basis for determining temperature limitations. The deterioration of paper is apparent chiefly in reduced ability to withstand tearing forces, bending or folding. Therefore apparatus for measuring one or more of these properties must be employed to make a satisfactory study of aging of paper. Descriptions of instruments for this purpose as well as data on a number of tests after various kinds of heat treatments were given in the author's complete paper.

If paper of uniform quality is subjected to a high temperature, the first effect noticeable is the greater



TIME REQUIRED FOR DETERIORATION OF PAPER INSULATION AT HIGH TEMPERATURES

ease with which the paper is torn. After longer heating it may be impossible to crease samples without cracking them. With a further degree of deterioration it is not possible to bend the paper an appreciable amount without breaking. A still further amount of aging produces a material which crumbles to a powder. The paper is not so sensitive to tensile tests as to tearing tests, since samples will show deterioration by tearing considerably before such effects appear in the tensile test. According to tests which have been reported to the standardization committee, the temperature of 85 deg. C. is justified as the maximum permissible temperature for underground cables because subjection of cable insulations to 93 deg. C. results in serious injury in about four weeks.

Impregnation affects the tearing resistance of the paper very slightly, according to tests. The great loss of tearing strength when the sample of paper is dried

and impregnated is said to be due to the change in moisture content and not to impregnation with compound. With the paper and oils used there appears to be very little difference between the aging effect at a given temperature of paper submerged in oil and paper exposed to air. This is contrary to the usual belief that the deterioration in air is much greater than under oil. This subject is said to require further study.

From the relation between temperature and number of hours required to produce certain definite amounts of deterioration it may be observed that the rate of deterioration doubles for a temperature increase of about 8 deg., at temperatures near 125 deg. C. Within the range of 100 deg. and lower, the increase of rate of deterioration with temperature is even greater, being roughly ten times as great at 100 deg. as at 85 deg. Thus it may be concluded that the annual rate of deterioration of a cable loaded so as to produce a temperature of 100 deg. C. for about two and one-half hours per day and a temperature much lower than 85 deg. for the rest of the day will be about the same as that of a cable loaded continuously so as to produce a temperature of 85 deg. Or, for a cable having a temperature of 100 deg. for two and one-half hours per day and of 85 deg. for the remaining time, the rate of deterioration would be nearly twice as great as for a continuous temperature of 85 deg.

Even after there are available sufficient experimental and laboratory data regarding the degree of deterioration occurring at different temperatures and under different conditions, the allowable amount of deterioration from the standpoint of operation of the cable still remains to be determined. As a definite limit the authors of the paper suggested a temperature which may be expected to produce a reduction of 20 per cent of the original tearing resistance of the paper after a period of, say, five years' time. This suggestion leads to the following temperature limit:

	Deg. C.
For continuously maintained temperature	78
For maximum temperature maintained five hours per day, temperature during remaining part of day low	85
For maximum temperature maintained two and one-half hours per day, temperature during remaining part of day low	90
For maximum temperature maintained one-half hour per day, temperature during remaining part of day low	100

Weight of Opinion Opposed to Higher Cable Temperature Rating

It Appears that Higher Temperatures Are Permissible, but Data Is Insufficient to Justify Changing the Temperature Rating

A BASIS for discussion of paper-insulated cable temperature ratings was laid down by Philip Torchio when he stated his conclusion that paper insulation under the lead sheath is in better condition to withstand 105 deg. C. than paper or varnished-cambric insulation on apparatus and machinery. He also expressed the belief that manufacturers are ready to guarantee cables at 100 deg. to 105 deg. C., provided the cables remain undisturbed in the ducts.

Most of those discussing this subject did not favor an increase in temperature rating, however, and urged that a better plan is to keep the present rating, which is considered safe, leaving the operating engineer to decide whether his conditions will justify operation at higher temperatures for short periods of time. It was the opinion of several of the speakers that there is not yet sufficient data at hand to determine what the hot-spot temperatures at inaccessible points in the ducts may be and that there are many variable conditions of undetermined importance involved in the problem.

After abstracting his paper Mr. Clark drew attention to two points of difference between cable and apparatus insulation—(1) that cables are guaranteed for five years and (2) that apparatus coils may be rewound readily. Mr. Fisher urged that A. I. E. E. rules be conservative since many companies do not have good facilities for controlling and observing cable temperatures, and in this recommendation G. B. Shanklin, W. I. Middleton, Prof. C. A. Adams and Dr. A. E. Kennelly concurred. Referring to the case of a torn cable sheath cited by Mr. Roper, Mr. Atkinson said the deterioration there might have been due to leakage currents instead of exposure to air since his tests did not indicate this harmful effect from such exposure alone. He also believed that standards not permitting reinstallation of cables were not justified, and C. N. Rakestraw amplified the point by saying that it was virtually impossible not to disturb cables when working on other cables in the same manhole.

Effects of Expansion of Cables Not Fully Known

In the matter of expansion and contraction of cables Mr. Shanklin did not believe enough importance had been attached to it. He also said that cables were expected to last twenty years. Prof. D. C. Jackson again called attention to the difference in expansion coefficients of the main elements of a concentric cable (two conductors, insulation and sheath). He said the different cementing materials used in class A insulation and cables might make a very appreciable difference in their resistance to high temperatures. E. B. Meyer and R. J. Wiseman agreed with Mr. Del Mar and Mr. Elden that cable temperature standards should not be raised. If they were raised, Mr. Meyer believed, actual temperature records would be required for financial adjustments.

Concerning the proposal to base temperature ratings upon load factor, P. H. Chase believed this would be a mistake, since the maximum load might last for a short time or a much longer time with the same load factor. Dr. Kennelly made a plea for actual measurements of cable temperatures by means of continuously recording temperature indicators installed at interior points in ducts. That the facts must be available and agreement reached before a change in standards is justified was Prof. C. A. Adams' belief and also that of F. D. Newbury.

H. R. Woodrow stated the economic problem involved in fixing temperatures at which cables should operate and H. C. Dean said experience on his system had indicated that high temperatures were not justified economically on account of the great I^2R losses. F. M. Farmer and W. I. Middleton commended the tearing resistance test of paper insulation.

D. W. Roper spoke of work being done by the British Electrical and Allied Manufacturers' Association and suggested that our National Research Council might take steps toward co-operation between the two countries.

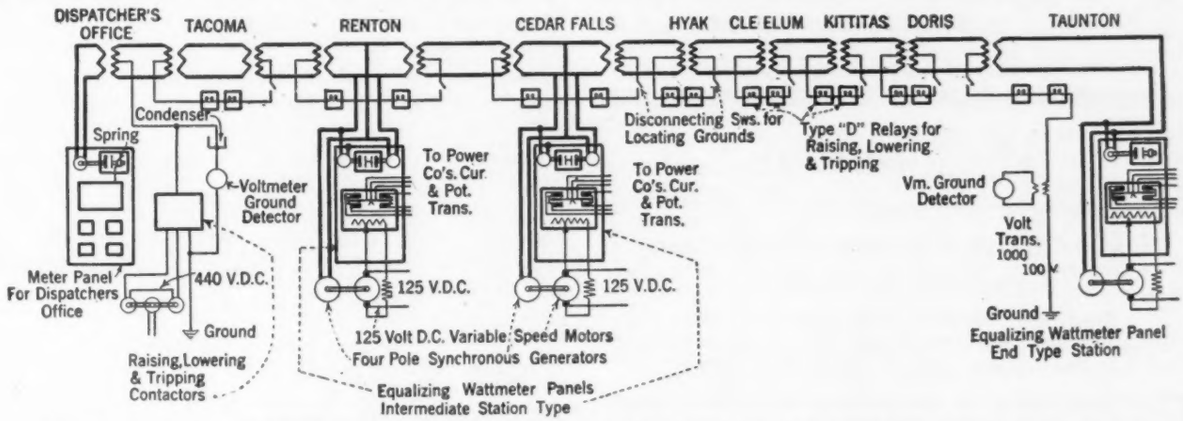
William Maver dealt with the early work on underground cables in 1889 and the years following when rubber-insulated and fiber-insulated cables were installed in New York electrical subways.

Meters and Measurements

Metering at Remote Points by Use of Frequency

Conditions Affecting the Transmission of Voltage or Current Are Eliminated by Meter, Depending on Adjustable Frequency

SINCE voltage drop is affected by resistance in the circuit and the current at any point is affected by leakage and induction, and since the transmission of energy is affected by both of these quantities, B. H. Smith of the Westinghouse Electric & Manufacturing Company pointed out in his paper, the problem of accurate metering at remote points has been a rather difficult one. Frequency, however, is not affected by any of these quantities, and this makes it possible to send out adjustable frequencies proportional to the energy consumption at any point and record the effect at a remote point either as indicating or integrated energy measurements. This is accomplished by connecting a wattmeter to a small alternating-current generator the speed of which, and hence the frequency, is proportional to the energy to be measured. Such a method is used on the electrified system of the Chicago, Milwaukee & St. Paul Railway for the purpose of supplying the load dispatcher with information. A base frequency of 25 cycles is maintained, so that if the load is zero 25 cycles is sent out. The frequency is increased up to 60 cycles for the maximum energy recorded. The control-circuit voltage is transformed from 100 volts to 2,000 volts for transmission to the recording station. For totalizing the energy being recorded the frequency at each station is increased by an amount proportionate to the power being received at that station. It is not done directly, however, but by another generator so controlled that its speed corresponds to the incoming frequency plus any power coming in on its own meter.



REMOTE METERING THROUGH THE USE OF VARIABLE FREQUENCY USED ON THE SYSTEM OF THE C., M. & ST. P.

Mr. Smith has shown that the line losses where the power control current was carried over both wires of the metering circuit and a ground return were so great that any attempt to meter by the direct transmission of either voltage or current would have been entirely inaccurate.

In discussing metering at remote points J. R. Craighead, General Electric Company, pointed out that the direct-current method had certain advantages, such as (1) that it is not affected by inductance or capacity, (2) there are fewer rotating elements to keep in order, (3) fewer wires are required, and (4) no phantom circuits are necessary. He also stated that leakage had not given trouble on the Montana Division of the Chicago, Milwaukee & St. Paul Railway. In reply, Mr. Smith said that on the Coast section of the line leakage had reached as high as 90 milliamperes on the power-control circuit, which uses direct current. For this reason the direct-current method was not practicable for metering purposes on this particular installation. C. F. Scott and W. H. Pratt also discussed the subject.

Limitation of the Stop Watch as Precision Instrument

Unreliability Great Defect in Modern Stop Watches—Inherent Errors Not Reduced by Adding More than Seven Jewels

BUILT for the non-technical public, the ordinary stop watch does not meet the requirements for engineering test purposes either as to accuracy or as to ruggedness, A. L. Ellis of the Thomson laboratory, General Electric Company, observed in the paper of which he was the author. Experience of more than twenty years in a manufacturing organization with more than 400 stop watches, including thirteen makes and nineteen models, indicates, Mr. Ellis said, that nearly all watches are in repair shops every two months, and in cases where their use is nearly continuous, as in meter testing, operation tests, etc., the intervals between repairs do not exceed two weeks.

A mechanically perfect stop watch will have an inherent error of as much as two-fifths of a second in a thirty-second reading, or at least one-half of this amount plus or minus the second limit. The addition of jewels to the number of seven in a stop watch is of some value, since the accuracy of the watch and its reliability of operation are increased for various positions. However, the further addition of jewels is not required, and the increased cost is out of proportion to any practical gain. It is to be hoped, Mr. Ellis said, that manufacturers will make a special effort to produce a stop watch suitable for all the classes of engineering work.

Mr. Ellis considered the errors which are found in the usual types of stop watches and discussed some of these errors from a technical viewpoint.

V. Karapetoff, H. M. Smith, W. J. Hammer, L. N. Potts and W. H. Pratt also discussed the subject.

Eddy-Current Measurement

AMONG the methods that have been investigated for reducing the eddy-current losses in cables, James A. Cooke, New York Edison Company, specified in his paper the impregnation of bare cables with varnishes and compounds to insulate the strands from each other and the insulation of layers of strands from each other by wrapping the layers with asbestos tape during manufacture of the cable. Measurements show, however, that the largest reduction is effected by impregnating the bare cable with sulphide solutions and then baking them. Mr. Cooke described a method of measuring eddy currents in cables and suggested methods of reducing the errors in making such determinations.

Wave Analysis Simplified

AN ELECTRIC network system for the analysis of alternating-current waves was described by F. S. Dellenbaugh, Jr., of the research division of the electrical engineering department, Massachusetts Institute of Technology. Long mathematical work is eliminated by this method, and the results are the same, he declared. Mr. Dellenbaugh also compared other methods of analysis with the electric analyzer, pointing out the advantages and disadvantages of each.

Miscellaneous

Short-Circuit Current of Induction Generator Is Serious

Conditions Identical with Those in Synchronous Machine Except that Transient Is Shorter and Current Dies to Zero Value

THE existence of a serious rush of current experienced in a short-circuited induction generator or motor was maintained in the paper of R. E. Doherty and E. T. Williamson, General Electric Company. This contention is in contradiction to a prevailing opinion that the current falls off immediately, which has led to the suggestion that induction generators be used to limit short-circuit currents on alternating-current systems. The authors declare that the conditions are identical with those in a synchronous machine, except that the transient is shorter and the current dies down to zero value.

To summarize the author's conclusions: (1) The sudden short-circuit current of a polyphase induction motor or generator, like that of a synchronous machine, is initially many times the normal rated current, and consists of an alternating-current and a direct-current component of approximately equal magnitudes in both primary and secondary. (2) The initial value of the root mean square of the alternating component is equal to the impressed voltage divided by the total leakage reactance. (3) Assuming the same leakage inductance, the initial current will be the same whether the machine is short-circuited as an induction machine or as a synchronous machine with the secondary excited with direct-current. (4) The leakage reactance under short-circuit conditions is lower than indicated by ordinary impedance tests. This is an important point to be considered in the design of large induction generators in which relatively low values of resistance may exist. (5) The actual duration of the transient is less than that indicated by the ohmic resistance and the reactance from impedance test, both because eddy currents increase the effective resistance and because saturation of leakage paths decreases. (6) Adding resistance to the primary winding will cause the direct-current component of that winding, and therefore the alternating component of the secondary, to die out rapidly, and it will prolong the transient of the primary alternating component and secondary direct-current. (7) The effect of load upon the value of the short-circuit current is virtually negligible.

Professor V. Karapetoff, Lawrence E. Widmark, Professor M. I. Pupin and Selby Haar discussed this paper.

Heat Flow in Slot-Wound Coils

FORMULAS for transverse and longitudinal heat flow in armature coils were worked out and checked by test results in the paper of Carl J. Fechheimer, Westinghouse Electric & Manufacturing Company. According to the tests there is very close agreement between the calculated values and test values for maximum temperature, minimum temperature and temperature at the end of the core, the exception being the maximum temperature at no load. There is slight difference between the calculated minimum temperature, considering transverse flow only, and the minimum temperature by test. On the other hand, there may be quite a large difference between the calculated maximum temperature, considering transverse flow only, and the maximum test temperature when the temperature is based on the maximum iron temperature instead of the rise. This applies even though the machine be of medium length, and the copper is worked at fairly high nominal current density with nearly negligible eddy-current loss. Thus it may be misleading, even in medium-length machines, to ignore the longitudinal flow.

R. B. Williamson, B. A. Behrend and Dr. Carl Hering commented upon this paper.

Great Future for Carrier-Current Communication

CARRIER multiplex telegraphy and telephony were discussed by E. H. Colpitts and O. B. Blackwell in an elaborate paper relating to the developments of the art. The propagation characteristics of open-wire lines were considered, including those lines containing intermediate lengths of cable. Commercial types of apparatus were described and actual installations were mentioned. It was pointed out that at present the apparatus is so expensive that the carrier-current system is economical only for relatively long-distance communication. Major-General G. O. Squier, in commenting on this paper, spoke of the wonderful development which is just opening in the radio field, especially in the range of higher frequencies. He mentioned that the navy had been experimenting with 200,000 cycles. Absolutely noiseless carrier currents, he prophesied, would be a development of the near future.

Dr. A. E. Kennelly claimed that such system as those mentioned in the paper would permit the present duplex systems to be set aside and the ground return to be discarded except in sparsely settled districts. He also foresaw that a higher type of man must be employed as a wire chief in the future.

Readers' Views and Comments

Water-Power Development in Public Parks

To the Editor of the ELECTRICAL WORLD:

SIR: The Pacific Coast States are, I believe, more directly interested in hydro-electric power enterprises which may to some extent involve land in national reservations and parks than all of the rest of the country. Therefore the observations of those closely in touch with the Pacific Coast section are the observations of those most vitally interested in the subject.

There are cases where a water-power development may be of questionable economy and at the same time would certainly destroy a scenic wonder or a beauty spot; but, on the other hand, there are certain projects of excellent economy which will create spots of beauty and charm where none exist at present. In still other cases the development will give a beautiful lake, for instance, in place of a certain waterfall. Take as a case in point, the Merced River above and behind the Yosemite Valley in California. The impoundage of the flood waters of this river would result in decreasing the flood flow, which occurs at a time when there are very few in the valley to see the falls, the valley being snowbound. This impoundage would prolong the season later in the year during which tourists flock to the valley to see the wonderful falls. At the present time the volume of water over these falls rapidly decreases in the early summer because of the quick run-off.

This is only one instance, but as in each instance there is so much to be said on both sides of the question, a definite law prohibiting development in national parks should not be enacted. It would be reasonable, however, that the decision in each instance should be placed in the hands of a federal department or commission for the exercise of careful judgment.

J. M. BUSWELL.

San Joaquin Light & Power Corporation,
Fresno, Cal.

Engineering Education in Our Universities

To the Editor of the ELECTRICAL WORLD:

SIR: In regard to the article in the Jan. 15 issue of the ELECTRICAL WORLD entitled "Electrical Engineering Students Increase" it is my opinion that words and printer's ink have both been lavishly wasted in recent years in putting on record the thoughts of various individuals regarding the increase in the number of students attending our universities now as compared with five years ago. I am further of the opinion that it is rarely of value to attempt to explain such occurrences. There are, of course, many reasons which can be very briefly stated, such as increased prosperity during the last five years and the conviction of many that the requirements of the war period proved the necessity for young persons of both sexes, and especially the men, having their minds properly trained for some useful service. Whatever the reasons may be, they are of little consequence as compared with the facts, and I am more concerned with a straightforward consideration of the increased responsibility of engineering institutions than with all the reasons for the increase which might be expressed in a volume devoted exclusively to that purpose.

Undoubtedly many students have undertaken engineering work in our universities and technical schools who are virtually without the natural intellectual endowment necessary to success in such a course. These students should be got rid of as soon as possible in all of our institutions. Even if this were done, however, there is probably not one institution in this country that is properly equipped and manned with the adequate staff of instructors to meet the present demands.

If our engineering institutions will stick to fundamentals, eliminating all informational courses, and insist upon a high standard of achievement in their classes, and if at the same time the necessary financial support is at once given to these institutions, then, in my opinion, the very best possible service will be rendered by them to the people and to the great engineering organizations and enterprises of the nation.

C. L. CORY,
Dean College of Mechanics.

University of California,
Berkeley, Cal.

Electrical Service in Argentina

To the Editor of the ELECTRICAL WORLD:

SIR: The Columbus Company for Electrical Enterprise of Glarus-Zurich has just published its annual report for 1920. This holding company is largely interested in foreign enterprises, especially in South America. Thus the Columbus company exercises the controlling interest in the Argentine "Compañia Italo-Argentina de Electricidad" of Buenos Aires. In reference to this latter undertaking the report says that in 1919 the Argentine company's plant for the generation of electrical energy had already been enlarged by the installation of a fourth group of turbo-generators of a capacity of 10,000 kw.—built by the Swiss Brown-Boveri Company—and during the last year another order for a fifth group of turbo-generators of the same capacity has been placed with the same Swiss company. Great attention had to be paid to the supply of fuel. In order to provide this on an efficient basis, a special fuel supply company, styled the "Compañia General de Combustibles," was formed at Buenos Aires with a capital of 3,000,000 pesos. This company has started the erection of large oil reservoirs at the Argentine capital and has acquired a number of tank ships for the transportation of the oil.

At the end of June of last year the Compañia Italo-Argentina de Electricidad had installed 28,000 connections of 76,000 kw., as against 25,000 connections of 67,000 kw. during the same period of the previous year. These connections included not only private ones, but also those of the city of Buenos Aires for public light, the requirements of the state for harbor works and those for the Southern Electric Tramways Company. The production of energy rose from 58,000,000 kw.-hr. in 1919 to 75,000,000 kw.-hr. in 1920, and the earnings of the company allowed the distribution of a dividend of 7 per cent against 6 per cent in 1919. The capital has been raised from 5,000,000 pesos to 10,000,000 pesos. The largest part of this increase was subscribed by the Swiss holding company.

HENRY L. GEISSEL.

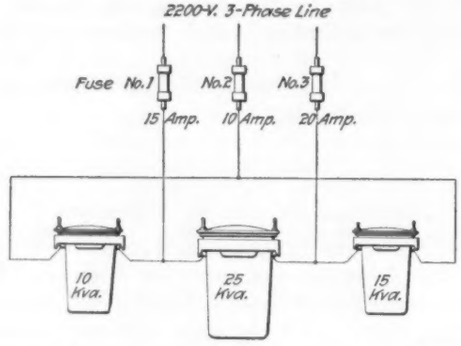
Münsinger-Berne, Switzerland.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Size of Fuses to Use for Distribution Transformers

THE correct size of a fuse to use with a 2,200-volt distribution transformer or any combination of transformers is quickly ascertained from the table shown here, which was prepared for the troublemen and line foremen of the Ohio Power Company, Canton division. To find the size of fuse for a single transformer



DELTA-CONNECTED TRANSFORMER BANK WITH SIZE OF FUSES SHOWN

the size of the transformer in kva. is first found on the top line of the table, and directly under it on the second line is found the size of the fuse. For transformers connected in delta or open delta it is necessary to use both the horizontal scale and the vertical scale of the table. For instance, with an open-delta bank the outside legs are fused the same as single-phase transformers of the same size. If the bank consists of a 10-kva. and a 20-kva. transformer, the outside legs have respectively 5-amp. and 10-amp. fuses. To find the size of

MAXIMUM FUSE SIZES FOR 2,200-VOLT TRANSFORMERS

Kva.	0 Single Phase	5	7½	10	15	20	25	30	37½	40	50	75	100	125	150	200
0	5	5	5	10	10	15	15	20	20	25	35	50	60	75	100	
5	5	5	5	10	10	10	15	15	20	20	25	35	50	60	75	100
7½	5	5	10	10	10	15	15	15	20	20	25	40	50	60	75	100
10	5	10	10	10	10	15	15	20	20	25	30	40	50	60	75	100
15	10	10	10	10	15	15	20	20	25	25	30	40	50	65	75	100
20	10	10	15	15	15	15	20	20	25	25	30	40	60	65	75	100
25	15	15	15	15	20	20	20	25	25	30	30	50	60	65	75	100
30	15	15	15	20	20	20	25	25	30	30	35	50	60	65	80	100
37½	20	20	20	20	25	25	25	30	30	35	35	50	60	75	80	100
40	20	20	20	25	25	25	30	30	35	35	40	50	60	75	80	100
50	25	25	25	30	30	30	30	35	35	40	40	50	65	75	100	100
75	35	35	40	40	40	40	50	50	50	50	50	60	75	80	100	150
100	50	50	50	50	50	60	60	60	60	60	65	75	80	100	100	150
125	60	60	60	60	65	65	65	65	75	75	75	80	100	100	100	150
150	75	75	75	75	75	75	75	80	80	80	100	100	100	100	150	150
200	100	100	100	100	100	100	100	100	100	100	100	150	150	150	150	200

fuse for the middle leg, the kva. of one transformer (20 kva.) is found at the left-hand column and the line is followed to the right until directly under the kva. of the second transformer (10 kva.) in the top line. At the intersection of these two columns is shown the size of fuse to be used, which is 15 amp.

For closed-delta banks all fuses must be calculated by using both scales. For instance, suppose that there are three transformers of 10 kva., 25 kva. and 15 kva. respectively, connected as shown in the accompanying drawing. In this case by consulting the table it is seen that fuse No. 1 should be 15 amp., fuse No. 2 should be 10 amp. and fuse No. 3 should be 20 amp.

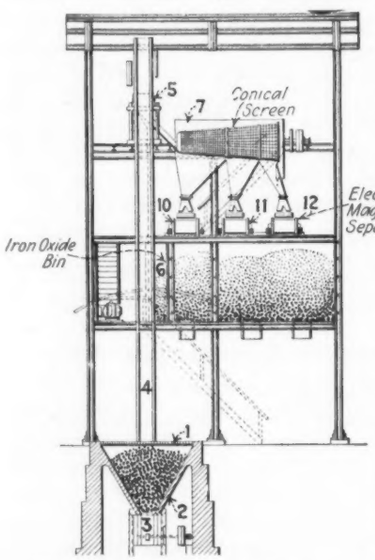
The fuse sizes given in this table do not correspond exactly with the ratings of the transformers, but they show the nearest size of fuse which is regularly carried in stock and which it is practicable to use with the transformer.

CARL A. WEGMAN.

Canton Division, Ohio Power Company.

New Process for Reclaiming Coal from Combustion Residue

A NEW process for saving unburned coal out of combustion residue has been developed by the Gruson Werke, a branch establishment of Krupp, in Germany, which, it is claimed, is simpler and quicker than the methods based on the different specific gravities of coal and clinker. The new process makes use of the magnetic qualities of the oxides of iron into which the sulphurous pyrites are transformed by burning and which are retained in the clinker. The basic principle of the process is the fact that the clinker, which contains ferro-oxides, responds to electro-magnetic attraction while the coal does not. The accompanying illustration shows a plant which has been designed for a combustion residue of 10 tons per hour. The ash is first put through the screen (1) with meshes 3½ in. (80 mm.) square. Pieces of unburned coal that do not pass through this screen are separated by hand from the clinker and carried off separately. All small pieces pass into the hopper (2) underneath and from there through the chute (3) into a bucket elevator which lifts them to the top of the square building containing the separating plant.



CLINKER SEPARATED FROM COAL BY MAGNETIC ACTION

Ash conveyed upward by bucket elevator (4) and after passing screen (7) five magnetic separators (as 10, 11 and 12) remove clinker.

The next step is the separation of iron from the ash, which is performed by the iron separator (5). The iron

sorted out falls into bunker (6), while the remaining material goes into a conical screen drum with different sizes of meshes. This screen separates the ash into four different sizes, 0-0.3 in., 0.3-0.8 in., 0.8-1.4 in. and over 1.4 in. (0-8, 8-20, 20-35, and over 35 mm.). The first three sizes are charged on to electromagnetic separators, (10), (11), (12) and two not shown, while the material over 1.4 in. (35 mm.) in size is taken to the crusher.

Separation of the clinker from the coal is performed by the electromagnetic attraction of the drums, on the surface of which the clinker is retained to a certain degree while the pure coal is thrown out by centrifugal force. The electromagnetic action counteracts to a certain degree the centrifugal force produced by the rotation of the drum and results in depositing the coal and the clinker respectively in different places, which can be kept apart by a wall. The pure coal is collected in compartments which have chutes at the bottom by means of which it can be loaded on trucks and carted away.

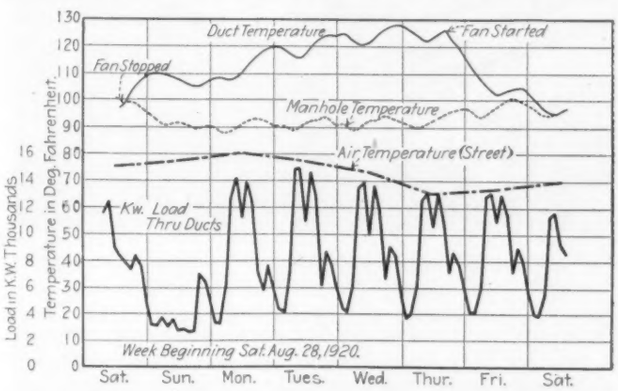
It has been found that a considerable amount of coal can in this way be recovered from the combustion residue, namely, 30 per cent from stationary plants and 40 to 45 per cent from locomotive ash. It is claimed that this new process besides other advantages has the merit that coal particles of every size can be recovered, while the small-sized particles are lost by the liquid treatment used up to now. Besides, the clinker obtained is absolutely free from coal and therefore better adapted for briqueting.

H. O. HERZOG.

Berlin, Germany.

Temperature of Cable Ducts Reduced by Blower in Manhole

UNDERGROUND conduit temperatures have been greatly reduced by the Toledo Railways & Light Company by means of a direct-driven blower installed in the manhole covers. As the blower and its supporting frame are portable they can be quickly taken to locations where abnormal temperatures exist, either temporary or of a permanent nature. The effect of the fan on the conduit temperature is shown on the curves



CURVES SHOWING REDUCED TEMPERATURE IN DUCT WITH MANHOLE BLOWER RUNNING

reproduced here. This shows the temperature with and without the fan.

The temperature record is secured by a recording thermometer with an 80-ft. capillary, which is inserted in the conduits midway between two holes. At this location there are approximately sixty conduits, 75 per cent occupied with cables carrying at the time of this chart peaks as high as 15,000 kw. in 220-volt direct current, 600-volt railway, 4,000-volt and 23,000-volt feeders. This chart does not represent the maximum temperatures experienced in this system, as at the time it was taken the atmospheric temperature was not above 80 deg. Fahr. During the very hot weather conduit temperatures have been experienced as high as 180 deg., and this great heat led to the development of this apparatus. Experience has shown that by the method described air can be circulated in the conduit system at sufficient velocity, even at high temperatures, to bring about safe operating conditions.

The outfit consists of a 15-in. Ventura wheel driven by a ¼-hp., 110-volt direct-current motor, delivering ap-

DUCT TEMPERATURE IS REDUCED BY MOUNTING THIS BLOWER IN MANHOLE OPENING

proximately 650 cu.ft. of air per minute, taking the air from the street and forcing it into the manholes. The direction of flow of the fresh air in a conduit system can be altered by plugging various ducts with waste. Reference to the photograph will show that the blower and motor are mounted on a steel plate which fits into the lower flange of the manhole cover. A conical hood is built over the fan to protect it from water, shedding the incoming water to a drainage ring outside the fan opening. The street cover plate is drilled to secure the same area for passage of air as the area of the fan opening. Energy is supplied through a two-conductor wire which is attached to the distribution box inside the manhole.

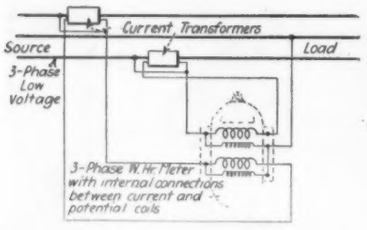
W. E. RICHARDS,
Superintendent Electrical Department.
Toledo (Ohio) Railways & Light Company.

Meter Installation Which Permits Easy Check on Connections

WHERE large amounts of three-phase energy are to be measured by a 5-amp., polyphase meter installed with current transformers on a low-voltage circuit the method of connection shown in the cut will minimize the likelihood of error and make possible a very simple and accurate check on the connections. In such installations it is extremely important to avoid the possibility of wrong connections, particularly those which will allow the meter to run forward on its normal load but with a large departure from accuracy. Such errors may easily be overlooked, with serious conse-

quences. With this method the ordinary house-service type of meter is used in which connections between potential and current coils are made inside the meter, the usual independent potential terminals being eliminated. The potential coils are energized by means of a tap connecting the primary and secondary of each current transformer. With these taps in place and the common potential wire connected to the third phase, the only possible error in connections is the reversal of one or both of the current-transformer secondaries. If the leads from the high-reading phase or both secondaries are reversed, the meter will run backward; if the leads from the low-reading phase are reversed, the meter will stop at unity power factor, run correctly at 50 per cent power factor and be increasingly fast as the power factor decreases.

The detection of such an error in current-transformer connections is a very simple matter. Assume that the meter is running ahead on its normal load and that it is desired to know whether the current connections on the low-reading phase have been reversed. Open the common potential connection by taking this wire out of the meter terminal block, leaving the two potential coils in series across the outside leads. If the meter has a separate potential tap for each element, these may be connected by a jumper. If the connections are correct, the meter will slow down to half speed in the forward direction; if the low-reading phase is reversed, it will run at half its previous speed but in the reverse direction. If the meter is so connected that it runs backward on its normal load, either the high-reading phase or both phases must be reversed. To determine which, open the common potential connection as above. If the high-reading phase only is reversed, the meter will run forward at half its previous speed, and if both phases are reversed it will run at half speed but backward. This is true for any power factor or any load, provided always that the load is approximately balanced.



INSTALLATION OF METERS IN THIS MANNER PRECLUDES POSSIBILITY OF ERRORS IN CONNECTIONS

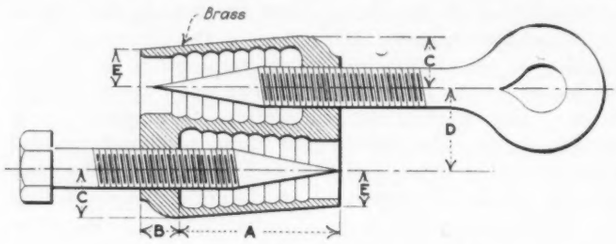
A study of the vector relations involved shows that when the potential connection to the middle phase is opened the phase relations are so changed that the former high-reading phase becomes the low-reading phase and vice versa. The phase angles between the potential pressures and currents remain the same, but the sum of the readings of the elements will be halved, as the potential coils are now in series across the line potential. If the low-reading phase current is reversed, it will assume preponderance and reverse the rotation of the disk.

This method is, of course, applicable in the case of a meter installed without transformers. However, in this instance the connections are usually more evident and an error is less likely. It will be found useful also for checking errors in internal connections of polyphase meters and reversal of the leads on polyphase standard meters.

ALBERT R. THOMAS,
Meter and Testing Department.
Southern California Edison Company,
Los Angeles, Cal.

Clamp Eliminates Soldering on Splices and Dead-Ends

A CLAMP for dead-ending and splicing cables which has proved useful in one of the electric railway substations of Chicago could also be used with advantage by many industrial plants. Instead of the old practice of skinning the cable installations back for about 20 in. or so from the end of the conductors for the purpose of making proper connection, only about 4 in. of bare cable is required for a strain connection or splice when this clamp is used. The bare end of the cable is slipped into a conical grooved hole in the clamp, and a pointed screw inserted at the closed end of the hole is screwed into the center of the cable. This forces out the cable against the grooved sides of the hole.



Dimensions for Dead-End Splice Clamp

Size of cable	A	B	C	D	E
4/0 to 350000 C.M.	2 5/8	1/2	11/16	1 1/4	9/16
500000 C.M.	3 1/2	3/4	1 1/16	1 3/4	7/8
1000000 C.M.	4 1/2	1	1 5/16	2 1/4	1 5/32
2000000 C.M.	2 5/8	5/8	15/16	1 3/8	19/32

DETAILS OF DEAD-END SPLICE CLAMP

The clamps are made of high-conductivity cast brass, and no solder is required to make the connection. The clamp has such a grip on the cable when the screw is in position that on a pull-out test a 1,000,000-circ.-mil cable broke under the strain but did not pull out.

DEAD-ENDS MADE WITH SPECIAL CLAMP WITHOUT SOLDERING. ONE CLAMP AT LEFT OF PICTURE HAS TAPE REMOVED

Chicago, Ill. W. H. WILLIAMS.

Avoiding Change of Phase Rotation

IN ORDER to prevent change in phase rotation of a line being worked on a New York State company makes it a practice to attach a rotation indicator to the circuit and leave it connected until the work is completed. On re-energizing the line a change of rotation is immediately noticed.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Keeping Shop Tractor in Shape

TO KEEP a tractor in running order it should be examined, oiled and greased every morning before its day's work begins. If any nuts are loose, they must be tightened up and perhaps held with lock washers or cotter pins. If there is too much loose play in the steering gear, have it taken up; also see that the machine steers easily and far enough toward both right and left. If the oil holes are filled with dirt, clean them out with a nail or wire so that the oil may reach the bearing it is intended for and not merely run over the outside. If the grease cups are screwed down tightly, remove them to see if they are not entirely empty or whether the grease is hard and thick. Remove the caps from the ball-bearing raceway of each wheel every few weeks and apply some soft grease like vaseline. One filling of soft grease on the driving gears will last about three months without attention, provided all the gaskets are tight. If the brake is loose, have it tightened properly as it is necessary to stop a small but heavy tractor very suddenly sometimes to avoid an accident. If the brake band is worn, have it relined, fastened with copper rivets and then adjusted to stop not too suddenly and so that it will not allow the tractor to proceed any great distance without coming to a positive stop. A tractor without a good brake is in danger of striking something or somebody, or it may roll down a grade and cause damage.

Solid rubber tires are ideal the entire year round on any kind of a road or floor, even on ice, snow or water. Their friction is more positive than that of either fiber or smooth iron tires, and they last several months even with almost constant use. These tires can be put on by almost any mechanic if a press of some sort is handy; the old tire can be pressed off while the new one is being pressed on if one is placed on top of the other. Every truck should carry a plainly stenciled shop number which will help in keeping a record of its repairs and charging.

Some tractors have the batteries removed for a new charge, while others can be charged as they stand by means of a suitable attachment plug. When a tractor is brought in for a charge its fuse, if it has any, should be removed. A fuse is a handy feature, as the driver can slip it into his pocket when the machine is to be left anywhere about the plant, thus preventing any one else from applying the current.

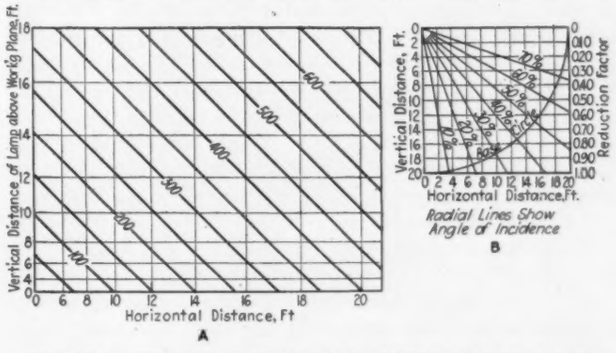
When the tractor gets very dirty from grease and dust a good washing with a hot-water hose will generally clean it, care being taken not to wet the brake band very much, which will cause it to slip considerably. If a compressed-air hose is handy, all the water can be blown off and no wiping will be required. A coat of paint once in a while on the body and wheels improves the tractor's appearance.

A good make of tractor can be abused to a costly extent by a careless operator, one who is given to speeding and then suddenly applying the brake, thus causing the machine to slide along a wet or oily floor. Starting from a dead standstill at full power may break the motor shaft and gears. Running slowly with the power on full and the brake only partly released will heat up the motor winding and the resistance coils.

East Berlin, Conn. H. S. RICH.

Diagrams to Assist in Illumination Calculations

IN THE solution of lighting problems by the point-to-point method the curve sheets reproduced herewith have proved very useful to the writer. The foot-candle illumination at any point is equal to the candlepower of the lighting unit toward that point divided by the square of the distance from the lighting unit. Diagram A is useful for quickly ascertaining this value. The foot-candle illumination on a horizontal surface depends upon the angle at which the ray of light strikes the surface. Diagram B gives the multiplying factor which must be used for the different angles of incidence.



DIAGRAMS FOR CALCULATING FOOT-CANDLE ILLUMINATION FROM CANDLEPOWER CURVES

In diagram A the oblique lines show the value by which the candlepower of the unit must be divided in order to obtain the foot-candle illumination at a point situated away from the lighting unit at vertical and horizontal distances, as indicated by the corresponding scales of the diagram. The right-hand scale of diagram B shows the reduction factor by which the foot-candle intensity must be multiplied in order to obtain the illumination on a horizontal plane. The radial lines show the degree of incidence of the light coming from a source at a distance as shown by the vertical and the horizontal scales.

As an example of the application of the diagrams, let it be required to find the illumination in foot-candles upon a horizontal plane produced by a lighting unit 8 ft. above the plane and 6 ft. away measured in a horizontal direction. From Diagram A it is seen that the 8-ft. vertical line and the 6-ft. horizontal line intersect on the diagonal line marked 100. This means that the foot-candles at the point under consideration will be equal to the candlepower of the light in that direction divided by 100. However, as the illumination on the horizontal plane is desired, this result must again be reduced on account of the fact that the light is striking the plane at an angle. To find this reduction factor

diagram B is employed. On diagram B the 8-ft. vertical line and the 6-ft. horizontal line intersect at a point approximately midway between the diagonal lines marked respectively 30 deg. and 40 deg. Therefore the angle of incidence is about 35 deg. From this intersection point trace radially down to the intersection with the base circle. The radial line cuts this circle opposite the point 0.80 on the vertical scale at the right of the diagram. This means that the illumination of the horizontal plane is 0.80 times the illumination calculated in the foregoing (which is the illumination on a plane at right angles to the ray of light). Therefore the illumination in foot-candles on the horizontal plane is equal to the candlepower of the lighting unit at a 35-deg. angle divided by 100 and multiplied by 0.80. Foot-candle = (cp. × 0.80) ÷ 100.

As another example: Suppose it is desired to determine the size of lighting units required to obtain an intensity of 8 foot-candles upon the horizontal plane if the lighting units are to be 8 ft. above the working plane and spaced at the corners of squares 8½ ft. on each side. A point on the plane directly under the center of the square formed by the lights would be approximately 6 ft. from a point directly under one of the lights. Therefore the point will be the same distance from the lighting units as in the preceding example, 6 ft. horizontally and 8 ft. vertically. As the light from four units will be effective on the point, each unit must furnish 2 foot-candles. As the angles are the same as in the preceding examples, the reduction factor is 0.80. Consequently 2 foot-candles is the intensity required from each unit. This value divided by 0.80 and multiplied by 100 (2 ÷ 0.80 × 100 = 250) gives 250 as the necessary candlepower of the lighting units along the 35-deg. line.

These diagrams may also be used for calculating the foot-candle illumination on surfaces which are not in a horizontal plane, provided that the angle at which the light strikes the surface is known. The same procedure is used as in the former case, except that in diagram B the two scales representing vertical distance and horizontal distance may be disregarded and the value is calculated from the radial lines representing the angle of incidence and the reduction factor scale on the right-hand side of the diagram.

C. W. KINNEY,
Worcester, Mass. Consulting Engineer.

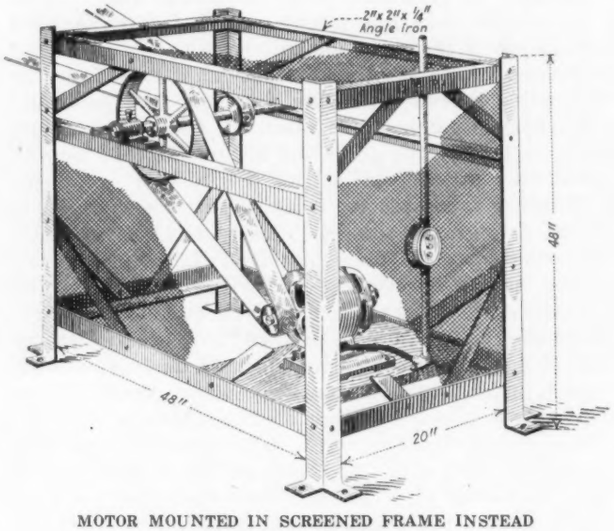
Maximum Temperature Allowable for Insulation—a Correction

IN THE Jan. 15 issue of the ELECTRICAL WORLD, page 154, an item appeared bearing the heading "Maximum Temperature Allowable for Insulation," which has created the erroneous impression that the figures as published apply to insulation used for any service. It should have been stated in the article that the data presented were abstracted from a report of the Industrial Control Section of the Electric Power Club (Bulletin 8,000, page 18, dated November, 1920), relating only to the temperature of coils for control apparatus. The information in the article, therefore, applied only to windings for coils to be used on control apparatus.

Attention is also called to the fact that the Electric Power Club did not recommend for adoption the figures referred to. The Industrial Control Section recommended certain specifications containing these figures to the Electric Power Club for use in the designing of coil windings for controllers. The report mentioned has not yet become part of the rules of the Electric Power Club and is simply in the form of a sectional committee report which will be subject to further consideration before becoming a part of the Electric Power Club standards. In its present form it was not intended for publication.

Individual Drive with Motor Mounted Separate from Machine

TO APPLY individual drive to machines on which a motor cannot be mounted, the motors in the Hamilton-Brown Shoe Company, St. Louis, Mo., are set up in an inclosed angle-iron frame. These machines are leased under the condition that the user is not to drill holes in them or to file or cut away any parts in order to attach motors. When the speed of a machine is such that it can be belted directly from a motor fastened to an adjacent part of the building no special problems



MOTOR MOUNTED IN SCREENED FRAME INSTEAD OF ON DRIVEN MACHINE

The construction shown in the illustration was designed for a 3-hp., 1,800-r.p.m. motor, but it has been used for 5-hp. motors at 1,800 r.p.m. Motors up to 2-hp., 1,800 r.p.m., have been mounted in frames built of 1¼-in. x 1¼-in. x ⅛-in. angle iron.

are encountered, but very often a countershaft is necessary, and when this is the case much overhead belting and shafting has been eliminated by the development of the framework as shown in the accompanying illustration. The motor with the countershaft and framework is a unit which can be moved from one similar machine to another. Furthermore, the relative positions of motor and driven shaft can be changed around to meet different conditions.

In fitting the drive to a machine the angle-iron framework is lined up with the main-drive shaft on the machine to be driven, and the framework is bolted to the floor or to the ceiling as the exigencies of the case may demand. The framework affords a safe and suitable place for mounting motor, starting switches, fuse blocks, switch blocks, compensators, etc. The framework is inclosed with a wire screen to conform with liability insurance and safety rules. The framework can be made of either wood or steel and has been used for motors up to 5 hp. normal rating.

Hamilton-Brown Shoe Company, ALBERT KOCHS,
St. Louis, Mo. Chief Engineer.

Armature Baking Reduces Number of Direct-Current Motor Repairs

ARMATURES are treated in the repair shops of the Brooklyn Rapid Transit Company by a baking, dipping and rebaking treatment. The method has reduced the number of armature repair jobs in the shop and improved service conditions.

When an armature is brought into the shop for overhauling it is stripped and the core is repaired, the commutator gone over and repaired and the armature rewound. The armature is then placed in the electric baking oven shown in the accompanying illustration and baked for ten hours at a temperature held between the limits of 240 deg. and 250 deg. Fahr. After this baking the armature is dipped in a black baking varnish. This dipping is done with the armature in a horizontal position, it being supported in the tank by the shaft and rotated in the varnish, which comes up only to the string band at the edge of the commutator mica "V" ring.

This method of dipping horizontally reduces the amount of varnish required, as the inside of the core is usually full of dirt and grease which cannot be removed and therefore does not take up varnish which would serve no useful purpose. The vertical method of dipping, especially when the armature is new, might be an advantage as all parts of the core would then receive a coat of the varnish and be protected from rust.

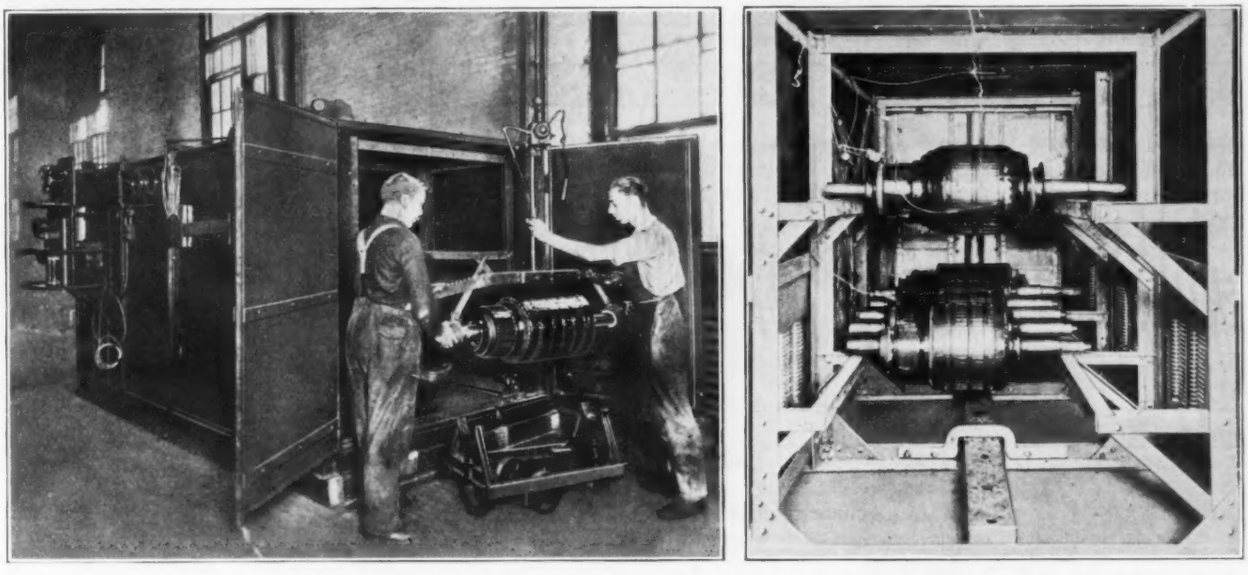
In the dipping process no particular attention is paid to the exact temperature of the armature when removed from the oven, although it is probable that as a rule each armature remains in the air some ten or fifteen minutes before being dipped. If dipped at too high a temperature the varnish tends to smoke, because of the volatile matter being driven off, although this seems to have no detrimental effect. After this dipping the armature is again baked for eight to ten hours at the same temperature limits of 240 deg. to 250 deg. Fahr. The range of armature ratings which are handled by this method is from 1½ to 150 hp. No distinction is made in the process between the various sizes, and as the length of baking time and temperatures are the same for the baking previous to dipping and the baking after dipping it is possible to have armatures going through both bakes on the same racks. The baking varnish which is used is one which will bake hard but will not become brittle. The advantages of treating armatures by this method might be enumerated as follows: (1) The coils are less subject to individual vibration; (2) all cracks are filled, which prevents the depositing of dirt or moisture; (3) loose laminations are sealed; (4) a coating is given to the core which protects the iron from rust; (5) bruised insulation is restored.

One disadvantage which might be called to the attention is the slightly increased difficulty of replacing a coil. However, in the experience of this repair shop it is hardly ever economical to replace the coil of an armature, but has been found a better operating practice to rewind the entire armature. The method of electric baking offers the advantages that a more even temperature can be maintained and that the process is automatic in its operation.

In the majority of cases electric energy is more easily obtained than the supply of live steam at a pressure of from 100 lb. to 200 lb., which is required for such work where steam is used for heating. The method, however, requires no elaborate equipment unless enough armatures are handled to place the work on a production basis. There is an opportunity for users of direct-current motors to treat the armatures by this baking method, even though the baking process be not carried out with the refinement allowed by the electric oven. It is possible to build the oven part of the equipment and possibly to install the heater equipment.

From experience the baking of armatures has been found to pay, and there is no reason to assume that the method would not produce excellent results for such types of equipment as electric mine locomotives.

As handled in the Brooklyn Rapid Transit repair shops the armatures are baked in the oven shown in the accompanying illustration. Two ovens of this type are in use, and the smaller sizes are placed in racks as shown in the right-hand illustration. The larger armatures, such as the 150-hp. size, are run directly into the oven on the type of truck shown in the foreground of the left-hand photograph. This truck is a standard



ELECTRIC OVENS USED FOR ARMATURE BAKING BY BROOKLYN (N. Y.) RAPID TRANSIT COMPANY

make and facilitates the handling of armatures in the shop. The armatures are lifted on to the rack with an air hoist. The oven shown in the illustration is 5 ft. 6 in. wide, 13 ft. long and 6 ft. high and has a capacity of eighteen armatures. The load of the oven when current is on is 50 kw. The current is probably on the oven about one-half of the number of baking hours, which would indicate a consumption of about 250 kw.-hr. for the baking of eighteen armatures. About 500 armatures are handled per month, requiring three barrels of the baking varnish and the services of three men.

FIELD COILS ARE IMPREGNATED

Of the 80,000 direct-current motor-field coils which are in use by the Brooklyn Transit Company about 50,000 have been impregnated in the repair shops. The additional 30,000 fields are wound with strap copper mica insulated and require no impregnating. When a field coil comes into the shop for repair the coil is rewound and taped with ordinary white cotton tape, after which it is impregnated with a compound that has an asphaltum base. The temperature of the compound tank is maintained at approximately 300 deg. Fahr., while the mixing tank is maintained at a temperature of 320 deg. to 325 deg. Fahr. The vacuum used for impregnating is about 27 in.

After the field coils have been impregnated they are a solid mass of the compound—so solid that a hard blow with a hammer will make no impression whatever. It has been found that no service trouble may be expected from field coils so treated, with the exception possibly of the terminal leads, which require renewing periodically. The compound seals all the cracks and makes the coil impervious to moisture and dirt. Each field coil is handled separately in this shop as no frames are sent in. The compound which gives best results is one which will not become brittle and will not chip on drying. The field coils should be placed on the poles as tightly as possible so that vibration will be reduced.

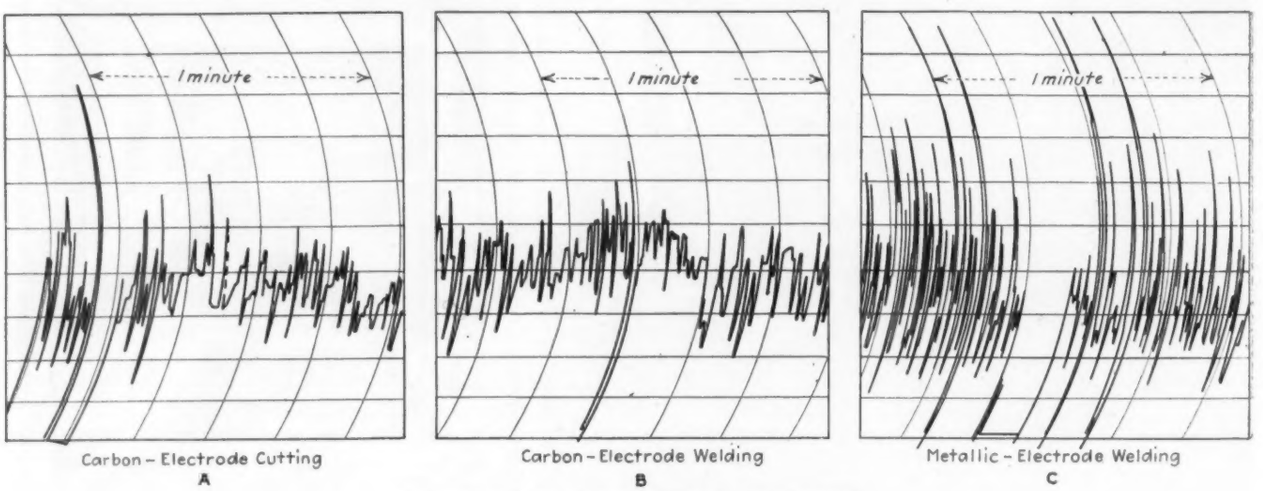
Most repair shops would probably not have the facilities for this impregnating work. After the field coil has been impregnated the outside insulation is placed and the completed coil is dipped in an air-drying insulating paint.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Load Curves of Arc Cutting and Welding

CURVES showing the current that flows through the arc on cutting metal by the electric arc, welding with carbon electrodes and welding with metal electrodes are reproduced in the accompanying illustration. These curves were made with the same meter connected to a 1,000-amp. shunt in the arc circuit. The energy was furnished by the same motor-generator set operating under identical conditions in the steel foundry of one of the large steel and iron manufactories in Pittsburgh. The motor is rated at 50 hp., 230 volts, 1,200 r.p.m., and the generator at 80 volts and 600 amp. With this set there is a reactance coil in series with the arc circuit, and also a switchboard with ammeter and voltmeter, rheostats, etc. The arc voltage in each case was from about 20 volts to 30 volts.

The outfit is used for cutting risers and fins from castings, cleaning out sand holes and preparing shrinkage cracks for welding by the use of the carbon-electrode arc. The carbon arc is also used for welding metal into large sand holes and welding the large breaks. The metallic electrode is used for smaller and more particular welding work where the carbon electrode would not be suitable.



CURRENT CURVES OF ARC CUTTING AND WELDING

A is cutting with carbon electrode, B is welding with carbon electrode and C is welding with metallic electrode.

In curve *A* it may be noted that the carbon-cutting work is comparatively steady; that is, the time intervals between fluctuations are large and the fluctuations are small.

In curve *B* the carbon arc-welding produces more rapid fluctuations, their magnitude being about the same as those of the cutting curve. In curve *C* the metallic-electrode welding produces very rapid current fluctuations which are of considerably greater magnitude than those in A and B.

As the heating, and therefore the loading, of the motor-generator set depends upon the root mean square of the current drawn, it may be seen from the curves that from the standpoint of power consumption and equipment maintenance the carbon-arc welding is more desirable than the metallic-electrode welding. The former should, therefore, be used whenever the character of the work to be done and other conditions will permit.

D. W. BLAKESLEE,
Pittsburgh, Pa. Consulting Engineer.

Troubles Prevented in Electric Precipitation Plant

TROUBLE with a high-voltage direct-current precipitation plant due to static and high-voltage oscillations has been overcome by methods which may be applicable to similar plants. The electrical apparatus of this particular plant consists of motor-generator set and control, transformer, mechanical rectifier, line discharge and collecting electrodes. In order to obtain the desired unidirectional current at from 60 kv. to 100 kv. a rotary air-break switch is used to rectify the current from a high-potential transformer. Two arms carrying a segment of brass at each end are mounted on a shaft at 90 deg. to one another as shown in the drawing. The arms are insulated from the shaft and from each other and revolve between the adjustable brushes, which clear the plates by 0.25 in. Electrical synchronism is obtained by driving rectifier and generator on the same shaft. The generator furnishes the primary current of the transformer, and the voltage is controlled by variation of the field resistance.

With the motor-generator sets considerable trouble

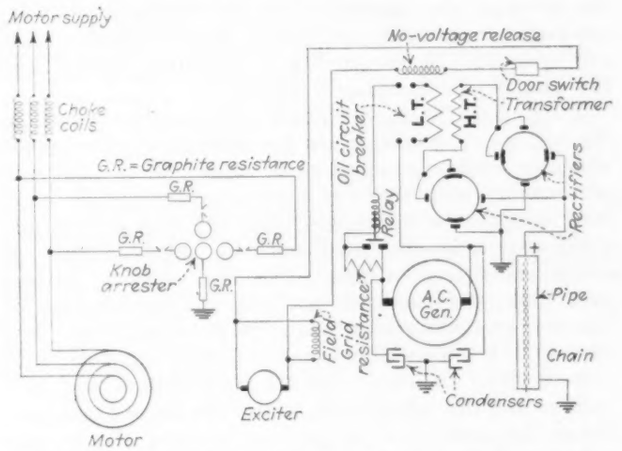


DIAGRAM SHOWING ARRANGEMENT FOR PREVENTING TROUBLES ON HIGH-VOLTAGE PRECIPITATION PLANT

Relay in generator circuit inserts resistance when oscillating currents become large. Condensers with grounded neutral point and connected across generator eliminate static. Choke coils and lightning arresters in motor leads prevent damage to motor.

has been experienced in the generators owing to a high potential puncturing the armature insulation and the power current following the high-potential arc burning the insulation and setting up a short circuit. This was due to one of two causes or a combination of both. Oscillations are set up in the high-potential line by the mechanical rectifier and also by the arcing between the discharge electrode or chain and the collecting electrode or pipe.

These oscillations are transmitted through the magnetic circuit of the transformer to the generator and set up a peak voltage much higher than the normal generated peak voltage and possibly high enough to break down the insulation in the weakest part of the circuit, this being the armature coils of the generator. The second cause of trouble is the static potential, which at times is very high, reaching 20 kv.

To prevent oscillations from becoming too great a relay is placed in the generator armature circuit. Normally this relay short-circuits a heavy grid resistance, but upon continuance of the surges the relay operates, removing the short circuit and inserting the resistance till conditions are again normal, when it resets itself. It has been proved beyond a doubt that a resistance in series with the low-tension side of the transformer greatly aids in obtaining smoother rectification and also increases the amount of the wave rectified. This object may likewise be accomplished by having this relay in the generator armature circuit to cut in and out resistance in the generator-field circuits. Normally this section of resistance is short-circuited, but upon a surge arising this short circuit is opened, thereby lowering the generator voltage until conditions have become normal again.

The static trouble was overcome by connecting across the generator armature leads two condensers in series with the middle point grounded as the drawing indicates. These condensers tend to absorb the static between line and ground and to absorb abnormal line oscillations.

Considerable trouble has been experienced with the motor winding going to ground caused by the insulation puncturing. This puncturing was due to static. To stop this trouble choke coils were inserted in the motor leads together with a three-phase knob lightning arrester with horn gaps and graphite resistances in series with each leg or phase. Since the installation of the choke coils no further motor trouble has been experienced.

As a general rule the operators found in these plants belong to the class with very limited electrical training, so that in order to safeguard the operator everything must be made as foolproof as possible. Accordingly the rectifiers are always inclosed in a cage with a door leading into them. By referring to the drawing a door switch connected to a no-voltage release coil on the oil switch connecting the generator to the transformer will be seen. Opening this switch opens the circuit through the no-voltage trip coil on the oil switch which connects the transformers.

If a man attempted to go into the cage before shutting down the machine, the door switch would immediately open the oil switch and cut energy off the rectifier.

R. H. N. LOCKYER.
Trail, British Columbia.

Repair Shop May Be Likened to a Hospital

IT IS common to think of the repair shop in industrial plants as the "hospital," but there the idea usually ends, although it can be carried further to advantage. A winding room ought to be "antiseptic" and therefore should be entirely removed from all machine-shop operations and shut off by a wall. A chip of metal in the insulation of a motor that is being repaired is like a germ in an open wound, sure to cause trouble later. This same idea applies with full force to commutator work.

To carry the thought a little further, it may be mentioned that in a hospital the patients who are cured are not left lying around in the operating room. So neither should repaired machines or parts be kept lying around the shop where other repair work is being done. A suitable storeroom, separate but accessible, with proper crane service, racks and protection from dirt, should always be provided for raw materials and finished work.

JAMES DIXON.
Reliance Electric & Engineering Company,
Cleveland, Ohio.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Bank Advertisements Commend Public Utilities

HOW the quality of service rendered by the public utilities has an important bearing on a city's growth and general welfare is evident from the advertising copy used recently by two of the largest national banks of Indiana. They are telling the public through advertising in home newspapers just what public utilities mean to their communities. The Fletcher American National Bank of Indianapolis is urging business to come to Indianapolis because of the electricity, gas and water, traction and telephone services afforded. The First and Hamilton National Bank of Fort Wayne is telling that city it should be proud of the utility services that are being rendered, one of the advertisements reading:

"Fort Wayne has reason to be proud of its public utilities. These concerns are carefully planning now that Fort Wayne's future growth may not be retarded. It is a matter of considerable importance for every Fort Wayne citizen to realize that our public utilities are looking carefully into the future that they may serve economically and well the growing city."

Characteristics and Costs of Domestic Water Pumping

WATER-PUMPING outfits in common use for house and farm water supply purposes range from the smallest size with a capacity of 100 gal. per hour, requiring a $\frac{1}{8}$-hp. motor, to those of 180, 250 and 300 gal. per hour, requiring motors of $\frac{1}{4}$ hp. to $\frac{1}{2}$ hp. Those for larger farms and estates have capacities of 1,000 gal. to 1,500 gal. per hour, requiring $1\frac{1}{2}$-hp. to 2-hp. motors. The needs of the average farm will probably be well provided for by outfits having capacities of 360 gal. to 720 gal. per hour, with motor capacities of $\frac{1}{2}$ hp. to 1 hp. Three hundred and sixty gallons per hour, or 6 gal. per minute, will supply a single $\frac{3}{4}$-in. garden hose. The storage tank provided will depend on the amount of water used, but practice in general leans toward the use of a tank only large enough to provide necessary elasticity and guard against unnecessary operation of the pump from reduction in pressure by leaky fixtures.

Tests made on several displacement-pump, compression-tank outfits of 100 gal. to 200 gal. per hour capacity showed over-all efficiencies of 15 to 25 per cent under normal operating conditions, with 17.5 per cent as a fair average. The efficiency increased with pressure, but the pump is likely to operate at a reduced pressure for a large percentage of its total operating time. Motor efficiencies varied from 40 to 60 per cent, with 50 per cent as a fair average. Thus the pump efficiency in this type and size of outfit may be expected to average about 35 per cent. These efficiencies result in a pumping duty of 2.1 kw.-hr. to 1.25 kw.-hr. per 1,000 gal. per 100-ft. head, with 1.8 kw.-hr. as a fair average.

Considering the capacities of these units, this figure compares very favorably with the average for the smaller city pumping units as shown by a series of tests throughout the state.

Watt-hour meters installed in several residences using compression-tank systems for soft-water supply to bathroom, kitchen and laundry revealed a maximum consumption of 0.75 kw.-hr. and an average of 0.45 kw.-hr. per person per month. So it is evident that at prevailing rates 1 cent per day for electrical energy is sufficient to provide an abundant supply of soft water for the average city family. For general water supply, however, where lawn sprinkling, stock watering, etc., are involved, the requirements are much greater and the cost is correspondingly higher.

Judging by the above figures on energy consumption, the soft-water requirements for a family of five people would be met by a pumpage of 1,250 gal. to 1,500 gal. per month, while for the general water supply on a farm equipped with modern plumbing and sewage disposal arrangements, involving the same number of people and fifteen to twenty-five head of stock, besides sprinkling and car-washing facilities, a pumpage of 750 gal. to 1,000 gal. per day would be required. But the rapidity with which farms are being equipped with these systems indicates that the up-to-date farmer considers that the advantages which are gained far outweigh the costs.

This information was presented by G. C. Blalock, assistant professor of electrical engineering at Purdue University, before the Indiana Engineering Society in January.

Commissioner Favors Public Utility Securities for Investment

WITH the view of obtaining from authoritative sources an unbiased survey of the investment status of public utility securities the New York *Globe* recently addressed the public utility commissions of different states with a request for an expression of their opinion. That such securities are considered inherently safe by the various commissions was indicated by the similarity of the replies in pointing out that the business is fundamentally sound and that under regulation the utilities are protected from loss due to operating costs beyond their control, while at the same time the public enjoys fair rates without discrimination.

Of particular interest is the opinion of Benjamin F. Cleaves, chairman of the Public Utilities Commission of Maine, in analyzing the public's attitude toward the utilities. He also points out that rates which have been increased to meet the higher cost of operating and financing cannot at once be lowered without re-

ducing the earnings of the company to a point below a fair return on the investment. In answering the request for his opinion Mr. Cleaves said:

I assume that it is not your purpose to ascertain whether the securities of a public service company which is improperly managed, unreasonably financed and in a situation which would render its securities of doubtful value are worth more or less on account of the mere fact that it is a public service corporation, but that you desire to know whether there is any inherent reason why the public may not safely invest in good public service securities to the same extent that the investor might place his money in the securities of a substantial and well-managed mercantile corporation.

CHANGED PUBLIC ATTITUDE

I believe that the answer to the question is found in the changed attitude of the general public and the reflex change resulting from that public attitude of public service commissions, this change having taken place within the last three or four years and being due largely to conditions obtaining during the war period and resulting in a better and fuller understanding upon the part of the public of the necessities of public service companies and their customers and of what constitutes not only fairness but good business to both. A few years ago a great majority of those people whom we refer to as the public believed that practically all public service companies were either making excessive profits or charging discriminatory rates, or had too much water in their securities, or in some other way were directly antagonistic to the public, and hence the public must in a retaliatory spirit be opposed to these corporations. This belief was privately and publicly expressed by individuals and in too many instances was featured and fostered by some of the public press. Somewhat naturally public regulatory bodies yielded to the force of this public opinion, and failed to accord to public service companies anywhere near fair treatment. Public service companies were in the meantime not entirely blameless.

Within the last few years the whole situation has very materially changed. Public service companies have realized that there is necessarily a full partnership existing between each corporation and not only all of its customers but all of the public in the territory being served. Into that partnership more recently have come the public service commissions, with full understanding and realization that they must perform fully and fairly the work of an equal partner.

The public itself has also learned a good many things. It is now very generally understood and universally conceded that no public service corporation which is rendering fairly an adequate and dependable service and is endeavoring to do the right thing can continue properly to function unless it is adequately supported, and that support must consist of something more than mere financial support. There must exist upon the part of each customer a belief amounting almost to conviction that the particular public service agency is worthy of support and is in fact a necessary, useful and likable part of the daily life of the particular community.

To gain that public support the managers of public service companies realize that they must merit it. This has resulted in a genuine attempt upon the part of such managers to give the best service possible, give full publicity to all matters in which the public has the slightest interest, and to place themselves in active and close touch with their customers. It has also resulted in a much better feeling on the part of the great majority of those customers.

SERVICE IS PARAMOUNT

Another thing which the customer has learned is that service is the principal thing desired, and that service of a dependable character is not obtainable unless the revenues are equal to the demands made upon the public service agency. Our particular commission has insisted to public service corporations that they were not authorized to have any secrets from the commission or the public, and that anything which the company did, or was authorized to do, was public property. We have also tried to educate the customers to a belief along the lines above indicated. In our own state I think I am justified in saying that the relations between the three groups—namely, the companies, their customers and the commission—are on a very much more workable basis today than they were even two years ago.

There is another situation which in the natural course of events will have its effect upon the value of the securities of a properly managed and financed public service company. During this period of increasing costs of operation very many of the public service companies have been obliged to increase their rates. Even under these increased rates the measure of return on the value of the property, figured upon a percentage basis, is today much less than that amount which would be regarded as a fair return. Otherwise stated, a company that three or four years ago was charging rates which yielded a return of 2 or 3 per cent above its interest charges is, even under the increased rates, receiving no greater percentage upon the value of its property.

RATE INCREASES SHOULD BE PERMITTED TO REMAIN IN EFFECT

When the decrease in operating costs comes I believe the regulatory bodies will permit the increased rates to remain in whole or in part in effect in order that a worthy company may receive nearer a fair return upon the fair value of its property. This will necessarily place such companies in a much stronger financial position, will give them an opportunity to make a better balance-sheet showing, and will therefore inspire a greater confidence in the investing public with reference to the value of their securities.

In a matter of this sort attention can be called to only a very few of the high spots, and I have not attempted entirely to cover the matter. I have merely endeavored to lay down the premises upon which I could state to you the conclusion that I personally see no reason why the securities of the average public service company shall not in the future be a safer investment than in the past, and no reason why such securities should not take their place in popular favor with the securities of a non-public-utility character.

Merchandising and Sales Policies of Central Stations

WHILE there are many central stations which confine their merchandising operations to selling lamps and a few appliances, leaving most of the business to be handled by the contractor-dealers, a survey made by the merchandising committee of the Southeastern Geographical Section of the National Electric Light Association showed that the majority of companies favor an aggressive sales policy. Some members did not approve of the sale of other than energy-consuming devices.

It was the consensus of opinion, however, that, even though a company's merchandising department were conducted only for the promotion of load-building business, if it expects to build a really large sales department it will be necessary to handle non-energy-consuming equipment, because so much of this is closely allied with the better lines of energy-consuming devices. Companies which have been merchandising most profitably and for the longest time strongly recommend the sales of accessories.

Best results in placing electrical devices in the hands of the consumer have been obtained by the smaller properties through the medium of intensive campaign work, while large companies conduct perhaps only two or three campaigns during the year, in the belief that a substantial, continuous flow of business cannot be

built up by campaign work, which is used by them principally for educational purposes.

Although no fixed rules for merchandising in every locality can be laid down, the following general principles have been found essential:

1. It is necessary that proper sales records and "prospect" cards be kept, that these be followed up closely and that such systems be kept accurate and alive at all times.

2. Periodical canvass work is necessary for ascertaining the ever-changing situation.

3. Outside representatives must be retained on some basis of remuneration which is equally beneficial to themselves and the company.

4. Outside representatives must be supported by inside representatives in companies where this is justifiable.

5. In all companies outside representatives must be supported by neat and attractive sales and demonstration rooms and, most important of all, well-trimmed show windows.

Sales methods of different companies were found to vary as to detail, but were similar in many respects in that the most successful sales campaigns are those which have been carefully thought out in advance and where rigid follow-up rules are adhered to. Four fundamentals, each of equal importance to any sales campaign, are given as originality, canvassing, follow-up of "prospects," and salesmanship.

Some companies have used very successfully the manufacturers' representatives as experts in their particular lines to assist in sales programs. The services of these men can be had for the asking and afford two distinct advantages: They educate the community and produce sales at no expense, and they make experts of the local salesmen.

In the opinion of the committee, the practice of price cutting to obtain business is unnecessary and a mistaken policy. Those companies which maintain prices are doing the most profitable business and have built up an organization which will continue to grow.

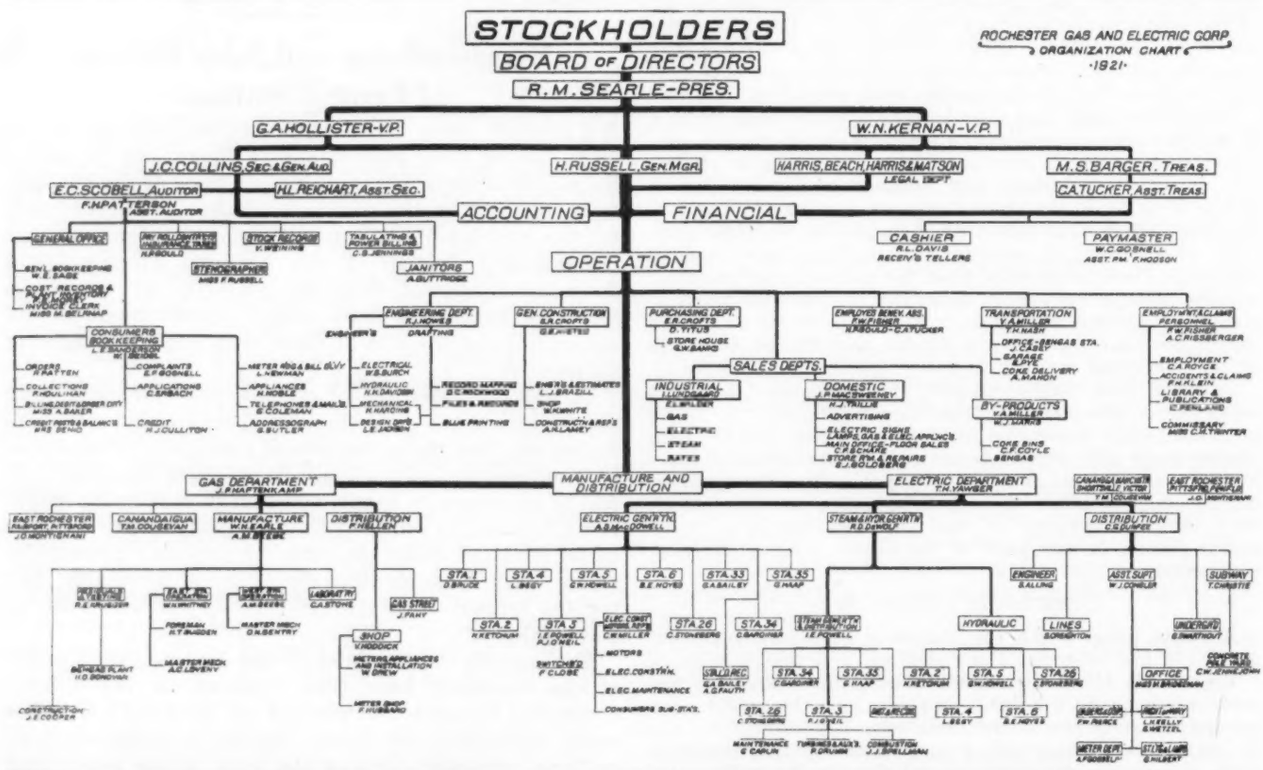
Consumers Pleased by Handling of Telephoned Complaints

THE day after a consumer of the Southern California Edison Company telephones in a complaint or a request for some minor service, such as replacement of blown fuses, a pleasant-voiced girl calls up the consumer and asks if the request has been properly taken care of or if there is anything further the company could do to be of service. It has been found that consumers are greatly pleased by this mark of courtesy.

In order to carry out the plan most effectively, when complaints are received the one receiving the complaint requests the name of the particular person who is telephoning in order that when the message is sent the next day it shall be possible to inquire by name for that person. This plan, which has just been put into effect, is to be used throughout the system of the Southern California Edison Company.

Organization Chart for Combination Electric and Gas Company

HERE is an organization chart prepared by the Rochester (N. Y.) Gas & Electric Corporation to show the relation of the company's personnel from stockholder to substation superintendent. In addition to showing the organization of the company the chart gives the names and indicates the responsibilities of the officers, engineers or superintendents in charge of departments, plants or divisions.



COMPREHENSIVE ORGANIZATION CHART OF THE ROCHESTER GAS & ELECTRIC CORPORATION

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Synchronous Motors for Ship Propulsion.—E. S. HENNINGSEN.—It is shown in this article that synchronous motors for ship propulsion must have the desirable induction-motor characteristics during starting and the synchronous-motor characteristics during running. How these characteristics, which may be conflicting, are harmonized in the design is explained. Motors and generators designed for ship propulsion differ from others because on shipboard both voltage and frequency are variable, and also because space, weight and accessibility for repair are of greater importance in marine work. Reliability, important in land service, is, it is contended, of even greater importance on shipboard.—*General Electric Review*, Feb., 1921.

Alexanderson High-Frequency Alternator.—E. BLAKE.—The principles upon which emfs. in the Alexanderson alternator are set up are described and constructional details of the alternator are considered.—*Wireless World*, Jan. 8, 1921.

Alternating-Current Motors and Control Equipment.—G. J. KIRKGASSER and E. W. SEEGER.—Common types of alternating-current motors are considered with special reference to speed control.—*Electrical Review*, Jan. 29, 1921.

Lamps and Lighting

Ship Lighting.—R. W. PEDEN.—The author dwells particularly on the importance of good lighting in case of accident when it is necessary for passengers to escape from the ship. The electrical fittings used on shipboard should be strong, substantial and rigid. There are three types found on modern vessels—(1) special ornamental or decorative fittings, (2) utility-type fixtures, such as are employed in staterooms, passageways, etc., and (3) watertight fittings for the engine room, the open deck, etc. A detailed discussion follows in which each division of the ship is taken up to show what the special requirements are.—*General Electric Review*, February, 1921.

Notes on Department-Store Illumination.—JULIUS DANIELS.—By means of a foot-candle meter a series of measurements were taken in department stores in New York, Boston, Philadelphia and Newark. It is shown how the data thus secured were used to increase the intensity of lighting of several of the stores which had been operating at low values.—*Transactions I. E. S.*, Dec. 30, 1920.

Generation, Transmission and Distribution

Design and Maintenance of Distribution Systems.—R. H. RICE.—Standards in the construction of distribution lines are discussed by the author, also the location of load centers, inspection schedule, line, transformer and service maintenance and records.—*Electrical Review*, Jan. 8, 1921.

Electrical Characteristics of Transmission Conductors with Steel Cores.—H. B. DWIGHT.—A method is presented by which the effect of the steel core of aluminum cables on the cable characteristics may be calculated.—*Electric Journal*, January, 1921.

German Insulator Standards.—Standardization of elements of construction is going on at top speed in the various commissions appointed by the Verein Deutscher Ingenieure. A second edition of the standardization rules for insulators has been published. Two sets of specifications are provided for subdivided insulators, one applying to cemented insulators, the other to such insulators where the different parts are fired together. There are also given detailed specifications for insulator testing. Electrical breakdown tests are made under oil. The voltage is to be raised from about seven-tenths dry flash-over value, in steps of 5,000 volts, one step every five seconds, till breakdown occurs. The breakdown voltage should be at least equal to one and three-tenths times dry flash-over voltage. Insulator porcelain is tested for porosity by soaking freshly broken pieces in a solution of 1 gramme (0.035 oz.) fuchsin in 100 gramme (3.53 oz.) ethyl alcohol and washing with pure methyl alcohol. No appreciable traces of color should remain on good porcelain after this test. In order to eliminate defective parts every porcelain element must have a factory test of fifteen minutes in air with alternating voltage of at least 95 per cent of the flash-over. The flash-over voltage is defined as the voltage which gives discharges at a rate of about three per second. Pin-type insulators are tested in water upside down and with the pinhole full of water. Ten per cent of each lot, or at least fifty insulators, must be thus tested, and if among these samples any breakdown occurs every insulator in the lot must be tested. Similar rules apply to high-voltage bushings and busbar supports.—*Elektrotechnische Zeitschrift*, Sept. 16, 1920.

Traction

Application of the Electric Locomotive to Main-Line Traction on Railways.—H. E. O'BRIEN.—In this discussion are given twenty-one advantages of electric locomotives over steam for main-line traffic and six disadvantages. Several tables are also presented giving a financial comparison, including both operating expense and investment.—*Journal Institution of Electrical Engineers* (London), September, 1920.

Italy's Great Railroad Project.—Nearly 4,000 miles of Italy's transportation system is to be electrified. All available water powers are to be developed and steam power is to be eliminated.—*Water Power* (official magazine Water Power League of America), Nov., 1920.

Maintenance on the B., A. & P.—F. W. BELLINGER.—Seven years of electrical operation on the Butte, Anaconda & Pacific Railroad under the severe conditions surrounding it have demonstrated the rugged qualities of the electric locomotive. To show that the maintenance costs with this type of motive power have been substantially less than with the steam engine a table of

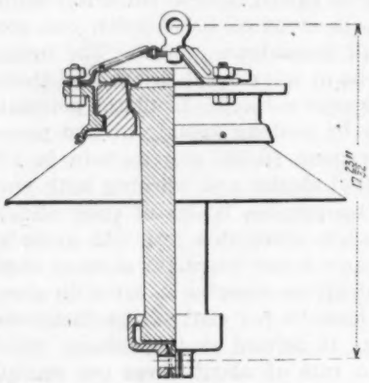
operating cost data for the electric locomotives is offered as follows:

	Cents per Mile
Maintenance of equipment expense, including repairs, supervision, shop machinery, tools	14.15
Locomotive engineers and firemen	11.55
Engine-house service	2.60
Cost of electrical energy	15.26
Lubrication	0.81
Other supplies	0.58
Total	44.95
Maintenance of equipment expenses (repairs) less supervision shop machinery tools	6.48

The author says that a force of thirty men in the shop suffices for inspection and repair work on this system.—*Electric Railway Journal*, Jan. 29, 1921.

Installations, Systems and Appliances

New Suspension Insulator. — G. GASTELNUOVO TEDESCO.—The insulator is shown in the drawing. The central rod, ring about its upper end and the cover are of porcelain. These are clamped together with a tripod attached to an eyebolt as shown. No cement is used in the assembly of the various parts. The metal cap at the bottom is screwed on two half rings. This insulator cannot be punctured by electric discharges and requires no electrical test before being used. If a discharge takes place it jumps from the petticoat to the metal cup, so that the porcelain cannot be damaged. The porcelain rod is subjected to tension, but as the pull required to break it is as high as 4,500 kg. nothing is to be feared. The insulator weighs 24 kg. Experiments made under rain showed that arcing took place at 95,000 volts; with two insulators in series it occurred at 170,000 volts, and with three insulators in series it occurred at 230,000 volts.—*Science Abstracts, Section B*, October, 1920 (Abstracted from *Elcttrotecnica*, July 15, 1920.)



NO CEMENT USED IN ASSEMBLY OF PARTS

Electrophysics and Magnetism

Graphical Tables for Computing the Self-Inductance of Choking Coils.—J. HAK.—The Stephan and Spielrein formulas for computing the self-inductance of coils being rather cumbersome to use in practical work the author has developed a special kind of alignment charts permitting a rapid determination of the necessary coil dimensions when the desired inductance is given, together with the current strength. The chart may be modified in many ways to fit special probelms, as shown by numerous examples illustrating the application.—*Elektrotechnische Zeitschrift*, Dec. 2, 1920.

Brush and Glow Discharges of Electricity and the Formation of Spark.—USABURO YOSHIDA and HIDEKI HIRATA.—The natures of positive and negative brush discharge, and especially the parts played by them in the formation of a spark, were investigated. It was found that the stronger part and the weaker part of a positive brush were different in their natures. The latter was a pilot of the former, and the arrival of the end of the former at the cathode or at a negative brush caused a spark discharge between the electrodes. An explanation of the formation of the negative and the positive brush was undertaken by the consideration of the ionization by collisions of the electrons and of positive ions with the molecules of the arc.—*Memoirs of the College of Science, Kyoto Imperial University*, Vol. IV, No. 3, February, 1920 (Kyoto, Japan).

Electrochemistry and Batteries

Rise and Development of the Electrolytic Alkali and Chlorine Industry in Europe.—JOHN B. C. KERSHAW.—An outline of the electrolytic cells employed in the electrolytic alkali and chlorine industry of the United Kingdom, Germany, Austria, France, Italy, Switzerland, Russia and Belgium.—*Chemical and Metallurgical Engineering*, Jan. 26, 1921.

Notes on Nickel.—PAUL D. MERICA.—Brief notes on the metallurgy of nickel, giving information concerning limitations in rolling, annealing, welding and electrodeposition.—*Chemical and Metallurgical Engineering*, Jan. 5, 1921.

Units, Measurements and Instruments

Defects in Electricity Meters.—WALTER LAWSON.—A classification for repairs which have been found necessary in experience with a large number of meters over a long period of time affords an opportunity to investigate the chief defects of these meters with a view to correcting the design. Both house and power station meters are considered.—*Journal Institution of Electrical Engineers*, London, August, 1920.

How to Correct for Error in Instrument Voltage Transformers.—J. B. GIBBS.—The problem involved in phase angle and change in ratio of transformation is worked out by showing how wattmeter readings are affected by these transformer errors.—*Power*, Dec. 28, 1920.

Telegraphy, Telephony and Signals

Recent Attainments in Wired Radio.—R. D. DUNCAN, JR.—The writer states that chief credit is due to Gen. George O. Squier for his early experiments with radio-frequency carrier currents combining the use of tuned circuits and a detector or rectifier at the receiving terminus. Thus the wire and radio transmission made use of the same conditions. Experiments are described using the telephone lines to study the possibilities of establishing communication over fairly long sections of line when employing extremely high carrier frequencies. It is said that no interference between the radio-frequency messages and ordinary telephonic and telegraphic signals being sent over the same line was produced. It is also said that, employing a system of high frequencies with power in the neighborhood of 2 watts, an excellent quality of telephonic and telegraphic signals was obtained between two railroad coaches, one of the coaches being stationary and the other coach in motion, over distances ranging up to 90 miles (145 km.).—*Journal Franklin Institute*, January, 1921.

Two New Vacuum Tubes.—PIERRE H. BOUCHERON.—A description of two new tubes, one especially designed and adapted for amateur radio-telegraph signal detection and the other applicable to the equally important field of radio and tone frequency amplification. Tests of the new tubes are given in the paper.—*Wireless Age*, February, 1921.

Books of Technical and Industrial Interest

COMPLETE LETTERS AND DIARY OF VERNE LEROY HAVENS. New York: McGraw-Hill Book Company, Inc. 94 pages.

On Jan. 31, 1920, V. L. Havens, editor of *Ingenieria Internacional*, one of the eleven McGraw-Hill engineering publications, left New York City for an extended business trip through South America. Mr. Havens sailed south by way of the Panama Canal and visited important centers of Peru, Chile, Argentina, Uruguay and Brazil. On July 23 he sailed from Rio Janiero for New York. During this six-month period Mr. Havens conducted exhaustive studies of trade and market conditions. It is rarely that the personal notes of an intimate study carried on by a trained engineer and economist are made available through publication, but Mr. Havens has supplied very valuable details of this sort by the publication of his letters and diary in a ninety-four-page pamphlet. The publication will be found invaluable to any one interested in the business of South American countries, whether he be an engineer or an executive, for incorporated in the notes are the results of the thinking of an engineer of extensive experience with an executive's business interpretation of the things he saw and heard.

SPOT AND ARC WELDING. By H. A. Hornor. Philadelphia: J. B. Lippincott Company. 296 pages, 61 illustrations.

The author has presented the subject of spot and arc welding from the standpoint of practical application, making the point that in his belief there still exists a hesitancy in applying welding to new construction, especially to the joining of heavy steel parts. A considerable number of tests made in the spot-welding of heavy steel plates by the Emergency Fleet Corporation are recounted in full. A study is made of materials with regard to the problem of making a weld that will be equal to the strength of the particular material to be welded. General application of arc welding, theories of electric welding and demonstrations of heavy spot weldings are taken up. A series of lessons for operators of arc-welding equipment are also presented.

EXPERIMENTAL WIRELESS STATIONS. By Philip E. Edelman. New York: Norman W. Henley Publishing Company. 232 pages, 167 illustrations.

A very handy amateurs' textbook, containing a large amount of useful information concerning radio telegraphy from the experimenter's point of view. The treatment is simple and the illustrations are clear. There are twenty-seven chapters in the book, relating to the following topics: Nature of wireless transmission, aërials, coil and sub-surface systems, grounds and lightning protection, the transmitter and resonance, wave length, transformers, auxiliary apparatus, condensers, inductances, spark gaps, radiation indicators, advanced systems, vacuum valves, tube radio telephones, the receiving station, detectors, sensitive detectors, tuning, special receiving sets, receiving condensers, construction of receiving inductances, making the set work, miscellaneous applications, time and weather signals, radiocommunication patents and rights of the experimenter. A good index closes the volume. The amateur will find the book very convenient for reference, and it contains much information that will be serviceable to the educated public.

MILWAUKEE ELECTROLYSIS SURVEY. Milwaukee: Compiled and printed by E. E. Brownell.

The author has taken the results of five different electrolytic surveys made for the city of Milwaukee and combined them to afford a general survey of this subject.

Books Received

THE NEW PHYSICS. By Albert C. Crehore. San Francisco, Cal.: *Journal of Electricity*. 111 pages.

GRUNDLAGEN DER ELEKTROTECHNIK. By A. Rotth. Leipzig and Berlin: B. G. Tuebner. 128 pages.

ENGINEERING ELECTRICITY. By Ralph G. Hudson. New York: John Wiley & Sons, Inc. 190 pages, illustrated.

SPACE AND TIME IN CONTEMPORARY PHYSICS. By Moritz Schlick. New York: Oxford University Press. 88 pages.

POWDERED COAL AS A FUEL. By C. F. Herington. New York: D. Van Nostrand Company. 338 pages, 124 illustrations.

WIRING FOR LIGHT AND POWER. By Terrell Croft. New York: McGraw-Hill Book Company. 448 pages, 426 illustrations.

LESSONS IN HEAT. By William S. Franklin and Barry MacNutt. Bethlehem, Pa.; Franklin & Charles. 147 pages, illustrated.

THE THERMIONIC VACUUM TUBE. By H. J. Van der Bijl. New York: McGraw-Hill Book Company, Inc. 391 pages, 232 illustrations.

LESSONS IN MECHANICS. By William S. Franklin and Barry MacNutt. Bethlehem, Pa.: Franklin & Charles. 221 pages, illustrated.

ELECTRICITY SIMPLIFIED. By T. O'Connor Sloane. New York: Norman W. Henley Publishing Company. 218 pages, 39 illustrations.

MODERN WELDING METHODS. By Victor W. Page. New York: Norman W. Henley Publishing Company. 292 pages, 113 illustrations.

A THOUSAND AND ONE FORMULAS. By Sidney Grensback. New York: Experimenter Publishing Company, Inc. 160 pages, illustrated.

HIGH-FREQUENCY APPARATUS. By Thomas Stanley Curtis. New York: Norman W. Henley Publishing Company. 270 pages, 150 illustrations.

DIE WISSENSCHAFTLICHEN GRUNDLAGEN DER ELEKTROTECHNIK. By Dr. Gustav Benischke. Berlin: Julius Springer. 640 pages, 602 illustrations.

ADVERTISING THE TECHNICAL PRODUCT. By C. A. Sloan and J. D. Mooney. New York: McGraw-Hill Book Company, Inc. 365 pages, illustrated.

THE STANDARD ELECTRICAL DICTIONARY. By T. O'Connor Sloane. New York: Norman W. Henley Publishing Company. 768 pages, 477 illustrations.

LESSONS IN ELECTRICITY AND MAGNETISM. By William S. Franklin and Barry MacNutt. Bethlehem, Pa.: Franklin & Charles. 254 pages, illustrated.

FUNDAMENTAL PRINCIPLES OF ELECTRIC AND MAGNETIC CIRCUITS. By Fred Alan Fish. New York: McGraw-Hill Book Company, Inc. 194 pages, 106 illustrations.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Boston City Council Opposes Edison Coal Clause

TWO orders attacking the inclusion of a coal clause in bills rendered the municipality by the Edison Electric Illuminating Company of Boston have been passed by the City Council. The first requests the Mayor to instruct the corporation counsel of the city to compel the company to refund to the city all moneys received from the municipality under coal-clause charges, dating from the time the company has been receiving coal under its contract with the mines, which was suspended by the federal authorities during the period of the war. The second order asks the Mayor to instruct the city auditor to withhold approval of all bills rendered by the company against the city for electricity that includes a charge under the coal clause.

No Indication that Power Commission Will Get More than $100,000

WITH only a few legislative days left, it is evident that the Federal Power Commission is going to be limited, at least until July 1, 1922, to appropriations t the rate of $100,000 per year. As this is written the sundry civil bill is in conference. It is believed that the Senate amendment which limits the salaries to be paid the chief accountant and to engineers to $3,000 and $2,400 respectively will be eliminated from the bill.

In view of a letter that was written to the chairman of the House committee on appropriations by the Secretary of War, any failure to eliminate the Senate amendment would be interpreted as indicative of a desire on the part of Congress that the Federal Power Commission should not function. In his letter Secretary Baker said in part:

> The commission has 175 applications, aggregating 13,000,000 hp., now awaiting action. It has a personnel of thirty-two individuals, loaned by the Departments of War, Interior and Agriculture. It will be able to perform only a small fraction of the work before it with such a force. Furthermore, this force is merely temporary. It cannot be assumed that the several departments will be able to continue such loans and at the same time perform their own departmental work which they are authorized and directed by Congress to do. The commission cannot and should not expect to secure a personnel for its work by any other means than direct appropriations therefor by Congress. If the work is not of sufficient importance to warrant such action, the federal water-power act should be repealed.
>
> It will be utterly impossible for the commission to perform its duties with a personnel limited in numbers and in salaries to that provided by the Senate amendment. The commission is required to prepare and to administer a system of accounting for licensing. The act requires that the system shall be similar to that prescribed for railroads and other carriers by the Interstate Commerce Commission. The work of both commissions in this respect is identical in character. The Interstate Commerce Commission is paying from $7,500 to $9,000 to the men in charge of this accounting division. The Federal Power Commission cannot secure a competent chief accountant or assistant accountant for the figures named in the Senate amendment. The effect of the amendment, therefore, would be to repeal by indirection all the provisions of the act which concern or are dependent upon the system of accounting.
>
> The commission is required to pass upon the plans and designs of projects of enormous magnitude. It will have to make valuations involving hundreds of millions of dollars. It is, of course, wholly impossible to do this with any engineering staff that could be secured for a maximum of $2,400 per annum.

Utility Commission Divorced from Industrial Court

THE amalgamation of the utilities commission of Kansas with Governor Allen's widely heralded industrial court has not proved to be so satisfactory an arrangement as was anticipated, judging by the action of the State Legislature in divorcing the two on Feb. 16.

By the terms of the bill, which is now ready for the Governor's signature, the Court of Industrial Relations ceases to have any jurisdiction over public utilities, and the Governor is to name a new utilities commission of three members which is to operate as originally intended before the industrial court was created.

Pupin, Inventor of Loading Coil, Receives Edison Medal

THE highest honor in recognition of electrical invention which the industry has to offer, the Edison medal, was bestowed on Dr. M. I. Pupin, professor of electromechanics at Columbia University, by the American Institute of Electrical Engineers on Feb. 18 for work in mathematical physics and its application to the electrical transmission of intelligence. It was Dr. Pupin's distinguished work in developing the "loading coil" which made possible long-distance telephone communication.

The important influence of Dr. Pupin's work upon wire and radio transmission was reviewed by J. J. Carty, vice-president of the American Telephone & Telegraph Company, and the medal was formally presented by A. W. Berresford, president of the Institute. In accepting the honor Dr. Pupin addressed the meeting on wave transmission.

Preliminary Superpower Survey Report Expected Soon

A PRELIMINARY report covering in a comprehensive manner the progress made thus far in the Superpower Survey is to be made public in the near future as a result of the meeting of the advisory board and engineering staff with the Secretary of the Interior

on Feb. 18. Secretary Payne expressed himself as being highly pleased with the progress of the investigation as disclosed at this meeting.

Those attending the meeting with the Secretary of the Interior were L. P. Breckenridge, M. W. Alexander, E. G. Buckland, Col. William Kelley, M. S. Sloan, Dr. George Otis Smith, G. N. Snider (representing A. T. Hardin), F. M. Feiker (representing James H. McGraw), W. S. Barstow (representing C. L. Edgar), W. S. Murray, N. C. Grover, O. P. Hood, Henry Flood, Jr., O. C. Merrill, H. Foster Bain, Alexander T. Vogelsang, P. S. Smith and J. C. Hoyt.

Massachusetts Companies Seek Right to Capitalize Premiums

THE right to capitalize premiums paid on stock is being sought by leading central-station companies of Massachusetts at the present legislative session in the interest of more convenient financing. E. W. Burdett, counsel for the Massachusetts Electric and Gas Association, addressed the committee on power and lighting recently upon a bill introduced by that organization which provides for the approval of the Department of Public Utilities before shares representing paid-in premiums can be issued. The new shares will be issued proportionately to stockholders of the date of the commission's certificate.

Mr. Burdett stated that the object of the bill is to remedy what is considered an error in requiring one stockholder or set of stockholders to pay more than others for the stock purchased by them from a company, instead of each receiving the full amount of stock for which he paid; to remove false values and the consequent misapprehensions and embarrassments thereby caused, and to create a wider and more favorable market for the stock of domestic gas and electric companies, first, by putting them within reach of a larger number of investors, especially those of small means, and second, by removing the handicap on their sale in competition with the securities of corporations organized outside of Massachusetts.

Under the present law increases of capital stock must be issued at such price (and at not less than the par value thereof) as determined by the directors and approved by the Department of Public Utilities. The result has been the issue of stock at an average premium of $39.17, and in the illustrative case of the Boston Edison company the average price received for its stock has been $179.54, resulting in a premium of nearly $18,000,000. In the case of the Lynn Gas & Electric Company the premium account is nearly as large as the par value of the entire capital, the exact proportion being 91.95 per cent. The diversity of dividend rates resulting from the varied premiums paid into different company treasuries causes misapprehension of the yield on the part of the public, creating an unfounded feeling of hostility, Mr. Burdett said. By bringing the nominal and real capital of the companies into harmony the percentage paid in dividends would be reduced substantially in harmony with the change in the value of the shares, the commission would be assisted in rate regulation and the market for securities broadened.

The bill was favorably reported by the committee and was in the Senate under discussion last week, a vote being expected this week.

Supply Manufacturers Complete Plans for Annual Meeting

PLANS are now virtually completed for the sixth annual meeting of the Associated Manufacturers of Electrical Supplies, to be held at the Hotel Biltmore, New York, on March 15. Because of cancellation of orders, deflation of inventories and adjustment of labor conditions, all of which contribute to a feeling of uncertainty and a spirit of economy and retrenchment, it has been decided to omit the banquet this year.

The following nominations for governors will be submitted to the meeting for election to take the place of those whose terms expire by limitation: S. H. Blake, General Electric Company, Schenectady; F. L. Bishop, Hartford (Conn.) Faience Company; A. H. England, Electric Service Supplies, Philadelphia; A. F. Mills, Crouse-Hinds Company, Syracuse, N. Y., and Robert Kuhn, American Electrical Heater Company, Detroit.

The following is a schedule of section meetings to be held at the offices of the association and at the Hotel Biltmore during the week of the annual meeting:

Tuesday, March 15.—Fuse Section, 9 a.m., association rooms; Electrical Porcelain Section, 10:30 a.m., association rooms.

Wednesday, March 16.—Fan Motor Section, 10 a.m., Hotel Biltmore; Outlet Box Section, 10 a.m., Hotel Biltmore; Industrial Lighting Fixture Section, 10 a.m., Hotel Biltmore; Snap Switch Section, 10 a.m., association rooms; Signaling Apparatus Section, 10 a.m., association rooms; Lamp Receptacle and Socket Section, 2 p.m., association rooms; Attachment Plug Section, 4 p.m., association rooms; Line Material Section, 2 p.m., association rooms.

Thursday, March 17.—Rigid Conduit Section, 10 a.m., Hotel Biltmore; Non-Metallic Conduit Section, 2 p.m., Hotel Biltmore; Armored Conductor Section, 4 p.m., Hotel Biltmore; Molded or Formed Insulation, 10 a.m., association rooms; Heating Appliance Section, 10 a.m., association rooms; Knife Switch Section, 2 p.m., association rooms.

Friday, March 18.—Panelboard and Switchboard Section, 10 a.m., association rooms; Air Circuit-Breaker Section, 2 p.m., association rooms.

South Dakota Hydro-Electric Plans Fail to Pass State Senate

ACTION by the State Senate last week will prevent any hydro-electric development by South Dakota for the present. Bills for development on the Missouri River at Mobridge and Mulehead were both overwhelmingly defeated. The Mobridge site was put forth by the State Hydro-Electric Commission, which has been looking for a suitable site for the past two years. Development of this site, it was estimated, would cost something over $16,000,000. Details were given in the ELECTRICAL WORLD for June 12, 1920, page 1390.

Utah Power & Light Offers Services in Municipal Plant Survey

A THOROUGH investigation of the proposal to erect a municipal electric lighting plant for the city of Ogden is requested by the Utah Power & Light Company, in a letter submitted to the city commission at its regular weekly meeting on Feb. 14. Recently the Mayor of Ogden announced that a bond election would be called to vote on the issuance of $500,000 bonds for the construction of a municipal lighting plant. The company offers its services in making a study of the problem.

New York Industrial Lighting Code to Be Revised

HEARINGS on revision of the industrial lighting code of New York will be held at different cities in the state within the next two months. Under the State Industrial Commission, the committee on artificial lighting, of which Thomas C. Eipper is chairman, has been working on changes in the present code adopted in 1918.

The proposed changes as approved by the committee embrace a more explicit wording of Rule 50, covering general requirements, methods of measurement, intensity, shading of lamps, distribution of light and emergency lighting. Illumination requirements now specify the minimum intensity for roadways, halls, stairways, storerooms, warehouses and manufacturing operations in general and were designed with the view to protecting the health of workmen, relieving eye strain and preventing accidents. At the same time these requirements were made as low as possible in order not to require the installation of expensive lighting equipment by factory owners.

Supplementing the code is a tentative table of minimum intensities for detailed industrial operation and processes submitted by the commission for the guidance of factory owners and operators. The data in the table are based upon actual tests, and it is the intention of the Industrial Commission to make these intensity requirements mandatory, together with the adoption of other revisions of the code.

The commission, in addition to making tests and gathering data for the revision of the lighting code, has done a great deal of work in correcting and improving illumination conditions in factories and industrial plants. That this work has been very effective and well received by factory owners is shown by the report for the fiscal year ended June 30, 1920. Of 12,293 orders issued for the correction of lighting conditions, there were 11,492 compliances. A number of the 801 orders remaining were canceled by the commission and a few are still pending.

Revisions of the code, Chairman Eipper said, are being made only after practical experience has demonstrated their advisability.

Midwinter Safety Meeting Next Week in Philadelphia

AS MUCH of the available data on the subjects of dust explosions, crane overhoist limit stops, signals and signaling in industry and the relation of boiler accessories to safety as can be gathered together will be discussed at the midwinter meeting of the Engineering Section of the National Safety Council, which is to be held in Philadelphia Feb. 28. The meeting is to be held jointly with the Philadelphia Section of the American Society of Mechanical Engineers and the Philadelphia Section of the Association of Iron and Steel Electrical Engineers.

The program is as follows: "The Engineering Aspects of Signaling," by A. H. Rudd, chief signal engineer Pennsylvania System, Philadelphia; "Crane Overhoist Limit Stops," by D. M. Petty, electrical engineer Bethlehem Steel Company, Bethlehem, Pa.; "The Relation of Boiler Accessories to Safety," by Warren Hilleary, superintendent of schedule rating Royal Indemnity Company, New York City; "The Lubrication of Air Compressors," by Dr. A. D. Risteen, director of technical research Travelers' Insurance Company, Hartford, Conn.; "Lessons from Electrical Fatalities," by S. E. Whiting, assistant chief engineer Liberty Mutual Insurance Company, Boston.

The program for the evening meeting includes two formal addresses to be followed by general discussion, as follows: "A Broader Field for the Engineer," by Prof. Dexter S. Kimball of Cornell University, and "Safety, the Fundamental of all Engineering," by L. A. DeBois, E. I. du Pont de Nemours & Company, Wilmington, Del.

Boston Edison Commercial and Operating Convention

THE first convention of the commercial departments and operating bureau of the Edison Electric Illuminating Company of Boston was held at the Edison Service Building in that city Feb. 16-17. About 130 employees attended, L. R. Wallis, superintendent of the sales department, presiding. Besides a free discussion of recent convention and other papers by other than company authors, the program included the following papers or addresses: "Sidelights of a District Salesman," by N. C. Fowler; "Illuminating Engineering," by Julius Daniels; "The Price of Electricity," by R. S. Hale; "Rates," by L. R. Wallis; "Information Department," by A. E. Josselyn; "The Application and Passing of an Order," by E. B. Locke; "Commercial Engineering and Power Sales," by J. W. Wattles; "Electric Cooking," by R. P. Loud; "Store Service," by E. M. Guest; "Historical Sketch," by H. J. Law; "House Wiring," by E. W. Childs; "Service Warrants," by E. C. Kimball; "The Work of the District Salesman," by W. P. Fiske; "Duties of a District Manager," by A. J. Ash; "Customers' Adjustments," by E. H. Gray; "Electric Appliance Development," by J. M. Braff. L. L Edgar and L. D. Gibbs also spoke.

N. E. L. A. 1921 Convention Headquarters

The Drake Hotel, Chicago, is a new building located on the shore of Lake Michigan and said by some to be the most modern hotel in the United States in every particular. The N. E. L. A. convention, which is scheduled for May 31 to June 3, will be the first to be held in the hotel following its completion.

Nearly 8,000 Common-Stock Shares Sold to 938 Persons in Ten Days

DURING the first ten days of its local stock-selling campaign, which started Jan. 24, the Southern California Edison Company made sales to 938 persons, who purchased 7,880 shares of the company's common stock at the par value of $100 per share. The price to the public was $94 a share when cash was paid and $95 on the installment plan.

The company plans to sell $10,000,000 worth of this stock during the current year and feels confident that it will be successful in this undertaking. In talking of this plan to the ELECTRICAL WORLD R. H. Ballard, vice-president and general manager, said:

"We have heretofore sold nearly $9,000,000 of this stock directly to the public and feel quite confident that our 1921 sales, in view of the 8 per cent dividend rate, will amount to an additional $10,000,000. So far as our own bank interests are concerned there is no friction. A buying syndicate composed of Harris, Rollins and the National City Company buy our bonds at wholesale—they are just now buying another $5,000,000—and then distribute these bonds all over the country through their own efforts and by allowing virtually all established smaller bond firms to participate. For instance, there will be half a dozen or so of such firms in Los Angeles selling these bonds locally. Instead of looking on our direct sales of the junior securities or stock to consumers and the public as being in conflict with their own efforts, they, on the contrary, urge us to pursue this method as being of great benefit to bond sales in the stability it gives the company as a whole, both in meeting promptly all of its financial requirements and in the credit strength of widespread public support."

Narragansett Company Saves $362,000 by Use of Oil as Fuel

A MORE than ordinarily interesting statement is contained in the annual report for 1920 of the Narragansett Electric Lighting Company, Providence, R. I. This statement refers to the economy effected by the use of oil fuel instead of coal, an experiment which has now lasted more than a year and appears to have amply justified itself.

"On Dec. 24, 1919," President Edwin A. Barrows says, "oil was first used as fuel under our boilers, two boilers being equipped to burn oil. Considerable experimental work was done in the early part of 1920 toward securing the maximum efficiency and minimum maintenance cost. At the close of the year, as the result of these experiments, the company had in all fourteen of the twenty-four boilers then constituting our equipment using oil. These fourteen boilers are in addition equipped with stokers so that reversion to coal burning can be made if desired. In January, 1920, 90 per cent of our power was generated by coal and 10 per cent by oil. In December about 35 per cent was coal-generated and 65 per cent generated by oil. This use of oil for fuel has effected a very large economy during the year, especially in the face of the abnormally high coal prices, and in addition economies have been effected by the reduction of labor and coal handling in storage. The company's customers have benefited by this large saving of over $362,000. Otherwise a considerable increase in rates would have been necessary."

The operations of the company during the year, the report says, have been the largest in its history, and in spite of business uncertainty the outlook for 1921 appears good.

Higher Salaries and Larger Force for Patent Office Seem Assured

NOW that several efforts by Senator Norris of Nebraska to obtain approval of the conference report on the Patent Office bill have failed, it is believed at this writing that he will abandon that section of the bill authorizing the Federal Trade Commission to administer patents for government employees. The Senate is willing to approve the portion of the bill which increases the salaries of the technical men in the Patent Office and which allows expansion in the size of the present force. The House has already approved the conference report, including the federal employee patent plan.

Financial Problems, Publicity and Other Topics Discussed at Albuquerque

TRUTHFUL publicity as the best means of establishing harmonious relations between public utilities and the communities they serve was urged by J. F. Greenawalt, publicity manager of the Mountain States Telephone & Telegraph Company, before the annual convention of the New Mexico Electrical Association, held at Albuquerque on Monday and Tuesday, Feb. 14 and 15. Prof. R. W. Goddard of the State College made an address on "Electricity," tracing its historical development and dwelling on the practical importance of technical research. "Electricity for the Bakery, Hotel and Restaurant" was discussed by J. F. Senior, who pointed out the large field afforded central stations by the electric range, which serves a business almost unaffected by hard times. Prof. Charles E. Carey of the University of New Mexico presented a paper on "Lightning and Lightning Protection," enumerating eight features in the design of lightning arresters which should be included or avoided and eight other factors which have an important part in assuring protection. A paper on the relationship of the jobber to the central station, by Hollis R. Johnson of the Commercial Electrical Supply Company, St. Louis, presented the business-getting problem from the jobber's point of view.

A letter was read from William H. Onken, Jr., editor of the ELECTRICAL WORLD, dealing with the financial situation in which electric light and power companies find themselves because inadequate rates and the federal tax laws make it difficult for them to find new capital. Mr. Onken defended the state commissions against political attack and urged the New Mexico Electrical Association to help arouse public sentiment in their support. He referred to the country-wide advertising campaign of good will launched by the National Electric Light Association and pointed out how essential it is to cultivate the understanding and friendship of consumers and the whole community.

Officers elected for the coming year are: President, Arthur Prager, manager Albuquerque Gas & Electric Company; first vice-president, D. E. Bent, manager Tucumcari Light & Power Company; second vice-president, E. A. Bradner, manager Las Vegas Light & Power Company; secretary-treasurer (re-elected), Charles E. Twogood.

Trial of Diesel-Electric Drive to Be Made on Oceangoing Freight Ship

DIESEL engines combined with the electric drive method of propulsion are to be installed in the American freight steamer *Fordonian*, owned by the American Mediterranean Steamship Company. It is estimated that two engines, each having 500 boiler-hp., will provide sufficient energy to drive the ship loaded at a speed of nine knots an hour.

The *Fordonian* was built in 1912 by the Clyde Shipbuilding & Engine Company at Port Glasgow, Scotland. She has a gross register of 2,366 tons and is 250 ft. in length. It is said that she will be the first deep-sea freighter to be equipped with internal-combustion engines supplying the power for the electric drive. This system was introduced on the Great Lakes several years ago, but did not work out satisfactorily. However, marine engineers said that it was not given a thorough trial.

To Move Town So as to Be Able to Build Dam

IT NOW seems practically certain that in connection with the construction of the American Falls reservoir on the Snake River in Idaho legislative authority will be given to purchase, condemn and improve land for a new town site to replace the portion of the town of American Falls which will be flooded by the new reservoir. The project calls for a 90-ft. dam, which would impound 3,000,000 acre-feet and make available for irrigation the entire water resources of the Snake River.

In addition to moving a large part of the town of American Falls it will be necessary to acquire the 6,000-hp. hydro-electric plant of the Idaho Power Company located just below the dam site. The proposed dam would make necessary the relocation of several miles of the Oregon Short Line Railroad. Indian lands as well as private lands would be flooded. This calls for time-consuming adjustments. All of these matters, however, are to be carried forward as rapidly as possible. Thus far arrangements have been concluded for the use of less than 1,000,000 acre-feet.

Brooklyn Edison Total Revenue Up $2,465,640 Over 1919

THE Brooklyn Edison Company's gross operating revenue for the year ended Dec. 31, 1920, as shown by its annual report, was $13,174,874, an increase of $2,465,640 over the previous year. Gross income, after deduction of operating expenses, taxes, reserve for renewals and replacements and inclusion of non-operating income, was $3,082,949, or $268,062 less than during 1919. The net income, after interest on funded and unfunded debt and bond discount, was $1,662,616, a decrease of $599,946 as compared with the year previous.

In the report attention is called to the high cost of material and supplies during the year and the consequent increased operating expenses. The report points out, however, that toward the end of 1920 the price of coal fell, and the company anticipates that it will obtain contract coal for its full requirements for 1921 at reasonable prices.

The new business obtained in 1920 exceeded that of any previous year. New power contracts were secured for an aggregate of 92,000 hp. The number of customers on Dec. 31, 1920, was 161,819, an increase of 36,295 for the year. Total kilowatt-hours sold during the year was 298,807,110, or 43,018,313 more than the year previous. The maximum load increased from 105,400 kw. to 116,500 kw.

During the year considerable new equipment was added. Two new substations were built and an existing substation was remodeled. Transmission and distribution systems were extended by the construction of 75 miles of 13,200-volt feeder cables for high-tension transmission and approximately 900 miles of feeders and mains, of which 385 miles are underground.

Consolidation of New England Hydro-Electric Companies Forecast

HENRY I. HARRIMAN, president New England Power Company, Boston, appeared before the committee on power and light of the Massachusetts Legislature Feb. 16 in support of a bill to facilitate the financing of hydro-electric companies, stating that the consolidation of the New England Power Company, the Connecticut River Power Company of New Hampshire (and Vermont) and the Rhode Island Power Transmission Company is sought by the controlling interest in these organizations. The proposed bill provides, first, that a Massachusetts electric utility owning a hydro-electric plant may issue bonds to an amount not exceeding twice the amount of the capital stock, instead of to an amount not exceeding the capital stock; second, if a refunding mortgage is issued and prior-lien bonds are placed back of it, the two bonds, one of which is collateral and the other original, shall not count as two; third, that such a utility may be permitted, when benefited by a reservoir in New Hampshire or Vermont, to own securities of such a reservoir company.

Mr. Harriman stated that the preliminary steps toward this consolidation have been taken, that an examination of the laws of about twenty leading states shows no such provision as the present Massachusetts requirement limiting bonds not to exceed the stock paid in, and that only the latitude already granted to street railways and railroads in the state is desired. Companies in Massachusetts, the speaker said, are handicapped in the marketing of their securities in competition with those of utilities incorporated in other states. The second provision is designed to offer more flexible financing, under commission supervision, through the omission of collateral bonds in counting the total allowed debt and through the adoption of interest rates responsive to prevailing market conditions. The New England Power Company system today represents an investment of about $30,000,000 compared with a mortgage of $2,000,000 ten or twelve years ago, and the rapid growth of these and other companies makes the use of serial bonds and other flexible financing necessary to further development.

The provision relative to storage-reservoir security ownership is designed to aid the financing and development of such facilities in cases where these are beneficial to companies outside the state within which the reservoir companies are chartered. Thus the Turners Falls (Mass.) Power & Electric Company and the New England Power Company interests have been respon-

sible for the construction of storage reservoirs in the upper Connecticut River which impound from six to seven billion cubic feet of water, and, subject to the approval of the Massachusetts Department of Public Utilities, it is desired that such corporations may participate in the ownership of the storage-reservoir companies, which are required by state law to be locally incorporated. Mr. Harriman said that in consolidating the three companies named by him it is desired to apply the rights already enjoyed in New Hampshire and Vermont to the combined company.

Connecticut May Extend Scope of Her Public Utilities Commission

A BILL has been introduced into the Connecticut State Senate by Senator Alexander L. DeLaney of Bridgeport to extend the scope of the Public Utilities Commission of the state to cover water, gas and electric companies in addition to the trolley companies, which now furnish the commission with its main field of activity. Hitherto the rates charged by the lighting, power and water companies have not been subject to commission control in Connecticut. The proposed act would bring the state in line with the majority of the states, in which the commissions exercise a wide jurisdiction.

Public Service Commissions Defended by Wisconsin Supreme Court

THE Supreme Court of Wisconsin, in a decision just rendered in the case of the Superior Water, Light & Power Company against the city of Superior, discusses at some length the reasons why regulation of public utilities through a state commission became a necessity. "The public utility law was enacted as a remedy for a well-recognized evil," the court declares. "The relations existing between the respective municipalities and their public utilities were most unsatisfactory. The impotency of the municipalities to deal with them so as to secure adequate and satisfactory service for reasonable charges was abundantly demonstrated. The officers of the municipality lacked the training in the technique of the public utility business which was essential either to protect the interests of the citizens or deal justly with the public utility company.

"Unreasonable demands made by the city as a result of a lack of information concerning the public utility business were as fruitless of just results as meek submission to the ultimatums of the utility. So it was determined to take from the municipalities the regulation and control of public utilities and vest that power with the Railroad Commission, which body, through its staff of experts, could acquire the information necessary to fix and enforce appropriate standards of service and just and reasonable rates which should adequately compensate the utility for the service rendered.

"It is believed that fourteen years of experience has vindicated the law as a measure of great public benefit, although recently, when abnormal industrial and commercial conditions have given rise to a general increase in rates of service, mutterings against the law or its administration may be heard. But it should not be forgotten that successful regulation must be fearless and fair, and accommodated to the exigencies of changing conditions. Critics should appreciate that private capital devoted to public service is entitled to a fair return, and that it requires more courage and character to render just than to render popular decisions."

Maine Governor Urges State Development of Storage and Water Powers

DEVELOPMENT of storage reservoirs and of undeveloped water powers incident thereto by the State was advocated by Governor Baxter of Maine in his recent inaugural address as successor to the late Governor Parkhurst, who died shortly after being inducted into office. Governor Baxter has long been greatly interested in water-power legislation, and as a legislator he advocated the retention of Maine's water powers for the benefit of Maine people, opposed federal interference with the control of these water powers, urged the appointment of a commission to obtain the facts about them for the benefit of the public, and was instrumental in attaching a restrictive amendment to such water-power charters as came before the last two legislatures. Speaking of the water-power legislative outlook in the state Governor Baxter said:

"The policy of non-transmission of hydro-electric energy beyond the state is supported by an overwhelming public sentiment, and in so far as the State of Maine is able to do so this policy has been safeguarded by law and by amendment. The Maine Water Power Commission, in my opinion, in its recent report has justified its creation and its continuance, as the only available channel through which the facts properly and impartially may be put before the people. Should the federal government attempt to assume control over Maine's water powers under the federal water-power act, or should any water-power corporation, in violation of the laws of this state and in disregard of the expressed will of the people, undertake to transmit the water powers of Maine beyond the confines of the state the Attorney-General will be directed to defend the rights and sovereignty of the state and to proceed against the offending corporation.

"Maine should not fall back into its former state of indifference to this vital question. Maine must advance. Private development should be encouraged and property rights must be respected. It need never be feared that the State of Maine will take property or rights from lawful owners without returning to them lawful compensation therefor. The construction of storage reservoirs and basins and the development of the undeveloped water powers incident thereto by the state should, in my opinion, be begun under proper safeguards after present restrictions are removed. Maine needs the benefit of its water powers, and the need becomes more pressing as years go by."

Business Men Want Stronger Illinois Commission

ON A REFERENDUM prepared by the directors of the Illinois Chamber of Commerce, 21,825 members out of 22,862 voted in favor of the state regulation of all public utilities, local or otherwise, by a state commission which should consist of men appointed because of their ability to give a non-political, unbiased and strictly businesslike administration of the commission's affairs.

Business Improvement Here and Will Grow Steadily, A. W. Douglas Says

REPORTS of traveling salesmen from every section of the country are to the effect that farmers are gradually marketing their crops, that bankers are beginning to make loans and extend credit and that a slow and natural working out of the processes of liquidation now in full operation will bring renewed prosperity in the near future. Lending full credence to these reports, Archer Wall Douglas, chairman of the committee of statistics and standards of the Chamber of Commerce of the United States, in his monthly review of business issued this week, asserts that the general thought inclines to early spring, March or April, as the date when distinctly definite improvement will set in, though in many parts of the cotton belt the belief is that June is early enough to expect a decided change. Scarcely any believe that present conditions will prevail throughout the year.

"All are agreed," Mr. Douglas adds, "that the only way to hasten matters is by the general exercise of the homely virtues of hard work and economy. A recent expression of opinion by a number of representative business men throughout the country brought out the significant fact that they were not so much concerned about the problems of labor, material, prices, transportation and collection, on the whole, as they were with the question of sales. In other words, when demand starts up, the whole tangled economic skein will begin to unwind. While non-employment is still large, there is more work and less idleness on the whole in industrial sections. The lessened production in manufacturing has naturally resulted in decreased output of coal. In the oil fields also there are falling prices accompanied by cutting down the output. Although building is practically at a standstill throughout the country, there exists the general expectation in nearly all sections of a revival in the early spring, provided lower costs, steady work and greater ease of money obtain."

Present-Reproduction-Cost Valuation Theory Criticised

IN GRANTING increased electric and heating rates to the Laporte Gas & Electric Company the Public Service Commission of Indiana recently dwelt upon what it holds to be economic unsoundess and legal anomalies in current theories of valuation, its viewpoint being somewhat at odds with the prevailing tendency of court decisions. It attacks the contention that present reproducion cost is the controlling factor, which, it says, tends to subject the utilities to "hazardous speculation, extreme financial uncertainty and obvious inequities." The contention, the commission holds, is in direct conflict with the contention supposed to support it, that utility property should be treated exactly like other private property, because the value of private property is its market value, and that is not at all determined by its cost of reproduction.

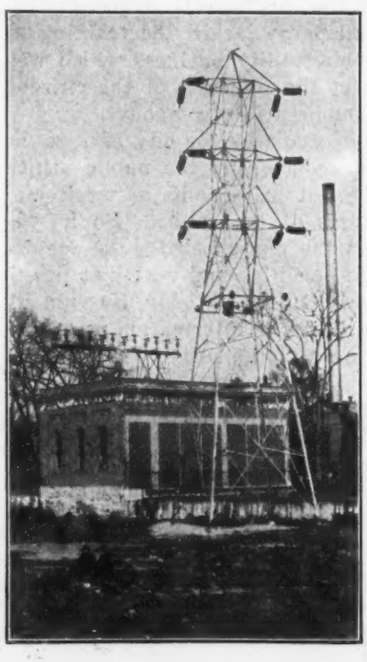
To apply the "market value" rule to public utility valuation would be a *reductio ad absurdum*, for market value depends chiefly on earnings, and earnings depend on rates, and rates depend on value. Nor does it logically follow that because the inventory used in valuation proceedings must be today's, therefore unit costs representing present costs of other units of property similar to the units in the plant valued must apply. The shrinkage in the purchasing power of money is a world-wide economic phenomenon due to fundamental social and economic factors, the commission insists, and all classes of society must be satisfied with decreased purchasing power until these factors are eliminated. To revise values in terms of the purchasing power of the dollar, whether such revision be up or down, is fundamentally unsound and might in the future involve utilities in bankruptcy. "The surest and most equitable method of insuring stability of values," in the commission's opinion, "is to consider prudent investment as the primary factor of value, thus insuring the utility against the evil effects of recurrent fits of economic fortune."

Well-Known Men to Address Oklahoma Utilities Association

THE third annual convention of the Oklahoma Utilities Association will be held at the Huckins Hotel, in Oklahoma City, on March 8, 9 and 10. The association is made up of electric light and railway, gas and telephone companies, manufacturers and suppliers. Among those who are announced to address the convention are H. J. Gordon, publisher of the *Public Service Magazine*, Chicago, Ill.; H. P. Wright, president H. P. Wright Investment Company, Kansas City, Mo.; Paul P. Haynes, member Indiana Public Service Commission, and C. C. Deering, secretary United States Independent Telephone Association, Des Moines, Iowa.

Georgia School of Technology Plans to Aid State's Industrial Development

AMONG other objects to be served by the fund of $5,000,000 which the Georgia School of Technology at Atlanta will launch a campaign to raise in April is the establishment of an industrial development department. This department, having in view the enormous natural resources of the state that still await use, plans to catalog and classify them, to bring them to the attention of capitalists and investors, to co-operate with civic bodies and public utilities, to conduct a general industrial service bureau, to compile for practical reference data pertaining to industry, to act as an industrial clearing house for the state.



Old Station Gives Way to Water Power

AS HYDRO-ELECTRIC energy enters by steel-tower lines this old central station at Torrington, Conn., goes into auxiliary service. A compact local substation now serves this normally busy manufacturing community.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Biggest Hydro-Electric Plant in Europe Projected.—The Diet of Moravia, a province of the former Austro-Hungarian Empire now constituting part of Czechoslovakia, has just approved a project for the construction of an immense hydro-electric power plant on the Thaya River. The works to be erected will, it is said, have a generating capacity of 80,000,000 kw.-hr. If carried out on this scale, the plant will be the largest of its kind on the European Continent. Leading Swiss banking institutions are reported to be interested in this project. The Swiss press, however, is strongly opposed to any such financial co-operation, basing its opposition on the fact that Swiss electrical enterprises have themselves to seek foreign money.

"Halting American Development."—Under this title Dr. William McClellan, former dean of the Wharton School of Finance and Commerce of the University of Pennsylvania and until recently vice-president of the Cleveland Electric Illuminating Company, has contributed an article to the February number of the *North American Review*. Dr. McClellan lays stress on the intimate connection that exists between the prosperity of public utilities and the general industrial progress of the country and points out that widespread development of the nation's resources is impossible when the agencies that furnish power and transportation are so restricted in their earnings that they cannot command the vast amounts of new capital necessary to their adequate expansion.

London's Supply of Electricity.—London continues to wrestle with the complex question of reorganizing its supply of electrical energy. The *Electrician* reports a partial solution, applying to the northeast district of the city, as worked out by E. M. Lacey and other electrical engineers. The district concerned has a population of nearly 2 000 000 and its present annual consumption of energy is 165,000,000 kw.-hr. In another year there will be an installed capacity of 92,000 kw. of efficient plant available, but, as this will soon be quite inadequate, the engineers recommend that a large station be erected with a capacity of at least 64,000 kw. at the outset. It is to contain five units of 20,000 kw. each and be designed for an ultimate capacity of 400,000 kw. The total cost of the station is put at £2,500,000. The cost of the transmission system for a maximum demand of 72,000 kw. would be £1,100,000.

Electrification of Melbourne Railways.—Nearly half of the suburban railway lines running out of the city of Melbourne, Australia, have been electrified, and it is expected that the rest of them will be so by the middle of 1923, the conversion, which was authorized in 1912, having been greatly retarded by the war. The London *Engineer* says that advantage is being taken wherever possible of the developments in electrical engineering since the war. For instance, the last two 14,500-kw. generators for one of the power houses will not differ outwardly from the generators already installed, but they will be capable of producing about 20 per cent more power with less fuel. Among other improvements will be automatically operated converting and switching plants at five substations and a new type of 20,000-volt switch gear occupying much less space than the old type.

Hartford's New Power Station.—The new station of the ever-enterprising Hartford Electric Light Company on the Connecticut River below the Dutch Point station is under way, and the engineers, Stone & Webster, expect that the first unit will be in operation in July next. This unit will be one of an eventual installation of five 20,000-kw. turbines, which can be doubled if the growth of business demands it. The building first constructed will afford room for three of these turbines with their auxiliary equipment. On account of the heavy floods to which the Connecticut River is subject, which cause a maximum difference in water level of 30 ft., it has been found necessary to place the condenser floor 20 ft. below high water and to make that portion of the turbine room below high water a watertight concrete box. The coal bunker extending across the boiler room will have a capacity of 2,000 tons.

The Demonstration Tidal-Power Plant at East Saugus, Mass.—The first plant of the Universal Tide Power Company is now under way at East Saugus, Mass., according to a report made by a committee of the Providence (R. I.) Engineering Society and based on the statements of the inventor of the machinery, J. A. Knowlton, and the engineer in charge of the earthworks and dam. This plant is for demonstration purposes only and is not intended to pay returns on the capital invested. The theory of its operation as explained by those behind the plan is, briefly, that the water which will be impounded in the river by the rising of the tide will on its recession run through a "hydraulic air motor," consisting of small reservoirs and floats, by means of which the water power will first be converted into air power. The energy in this compressed air is then to be converted into electrical power by means of an "air engine" and an electric generator. Mr. Knowlton estimates that 5.8 ft. of the entire tide range of 9.4 ft. will be used and that the plant will develop 37 hp. an hour continuously twenty-four hours a day. The cost of the plant is put at $200,000.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Joint Meeting of A. I. E. E. and A. S. M. E. in New York.—The fourth of the joint sessions of the New York Section, A. I. E. E., and the Metropolitan Section, A. S. M. E., is announced for March 25, when the topic will be industrial relations. Prof. Walter Rautenstrauch will be in charge.

Providence Engineering Society.—At last week's meeting John M. McMillin of Henry L. Doherty & Company gave an illustrated talk under the auspices of the Municipal Section of this society on "Relationship of Public Utilities to the Public." The Power Section is to meet on Tuesday, March 1, when Henry Kreisinger of the Combustion Engineering Corporation will speak on "Fuel and Its Combustion Under Power-Plant Boilers." On March 15 the society will hold a joint session with the A. I. E. E., and C. C. Whittaker of the Westinghouse company will discuss the electrification of steam railroads.

Empire State Gas and Electric Association.—The electric production and distribution sections of this association met at Rochester, N. Y., on Feb. 10 and Feb. 11 respectively. Before the first-named section F. A. Dresser of the Cortland County Traction Company read a paper on "The Problems of the Small Plants," and O. W. Bodler, electrical engineer with the Eastman Kodak Company, spoke on "The Importance of Close Voltage Regulation in Industrial Plants." Before the distribution men, John P. Hogan talked on the hydro-electric situation in New York State. E. P. Peck of the Utica Gas & Electric Company read a paper on "Testing of High-Tension Insulators Before and After Installation," and Francis A. Westbrook of the Habirshaw Electric Cable Company discussed aërial power cables and grounding transformers.

Coming Meetings of Electrical and Other Technical Societies

Engineering Section, National Safety Council—Philadelphia, Feb. 28.

Providence Engineering Society—Providence, March 1.

Association of Iron and Steel Electrical Engineers—Philadelphia Section, March 5; Cleveland Section, March 14; Birmingham Section, March 19; Chicago Section, March 22.

Oklahoma Utilities Association—Oklahoma, March 8-10.

American Institute of Electrical Engineers—New York Section, March 11; Providence Section, March 15; Schenectady Section, March 18.

Associated Manufacturers of Electrical Supplies—New York, March 15.

Wisconsin Electrical Association—Milwaukee, March 23 and 24. (For program see issue of Feb. 19, page 448.)

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section)—New York, March 25.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Powers of Oklahoma Commission Upheld.—That the Corporation Commission has a right to control and supervise rates and contracts entered into between two utilities or public service corporations where such rates are "unconscionable, oppressive and impair obligation of the public service corporations in their discharge of their duty to the public" was the holding of the Supreme Court of Oklahoma in denying the application of the Oklahoma Gas & Electric Company for a writ to prohibit the Oklahoma Natural Gas Company from establishing a city rate to replace the present contract with the Oklahoma Gas & Electric Company, which provides that the latter shall pay two-thirds of its gross receipts to the Oklahoma Natural Gas Company for the gas received from it.

Right of Condemnation Sustained.—An electric power company, according to the findings of the Supreme Court of Tennessee in Barger vs. Knox County Transmission Company, did not lose its right of condemning land for public use because it did not supply non-remunerative customers along a certain line, nor because of a contention that its right-of-way was improperly located, nor because it did not generate its own electricity but acquired it from another company, nor because it was affiliated with or promoted by other companies, nor because it was accused of violating the anti-trust laws; nor were the state laws under which it was sought to exercise the right of eminent domain in violation of the state constitution because they did not restrict to a public use alone the property authorized to be condemned. (225 S. W. 1046.)*

United States Court Sustains Power of Kansas Commission to Change Contract Rates.—An action of the Wichita Railroad & Light Company against the Public Utilities Commission of Kansas to restrain it from putting into effect an order granting increased rates to the Kansas Gas & Electric Company was decided in favor of the plaintiff by the United States District Court, and the commission carried the case to the federal Circuit Court of Appeals. That body reversed the decree of the District Court, holding that the commission had full power to issue the order, that the commission could permit a utility to charge rates in excess of those fixed by contract with consumers without impairing the obligations of such contracts, that the commission could authorize increases in the rate of utilities through specified surcharges, and that the order of the commission should be sustained. (268 Fed. 37.)

Powers of Courts and Commissions Over Rates.—An appeal was taken to the New York Supreme Court, Appellate Division, from the decision of the Special Term which granted an injunction to consumers of the Brooklyn Borough Gas Company in restraint of an increased rate permitted by the Public Service Commission, First District. (See ELECTRICAL WORLD, Jan. 22, page 228.) The Appellate Division has affirmed the order of injunction, which, the statutory rate having been declared unconstitutional, left no way for the company to arrive at an equitable rate save by judicial action. A dissenting opinion was filed in the Appellate Division by two judges, who upheld the commission's powers and asserted: "Prescribing a general rate for service is a legislative and not a judicial act. It may be exercised by the Legislature directly or by an administrative body to which the power is delegated. In the absence of such regulation the power to fix the charges is vested in the corporation itself, and, although a question may arise as to the reasonableness of the charge, depending upon the service rendered, as between an individual and the corporation, such question never concerns the power of the corporation to establish a system of rates. In the absence of such legislative regulation the courts have no power to determine the question."

Preferential Contracts Properly Annulled by Commission.—A suit brought in the California Supreme Court by Hartland Law against the Railroad Commission because he was forced by that body to pay to the Great Western Power Company rates fixed by the commission in spite of the fact that he had a twenty-year contract at lower rates has been decided in favor of the commission. The commission's view, to which is due a dispute of long standing, is that wherever there are favored consumers enjoying special rates under the terms of contracts like the one in question—where the utility company, in consideration of the use of certain machinery and appliances in the complainant's building, agreed to furnish steam heat for a period of twenty years at a low rate—there necessarily results an outright discrimination in favor of such consumers and an additional burden upon all others. The court declares that "It is not essential that a rate be greater or less in amount in order to be discriminatory; a difference in character of payment, such as the granting of privileges or concessions, may in itself give just such advantages as the act is designed to prevent." The holders of such special contracts may, the court indicates, seek restitution from the power company of any property rights given up in return.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Efficiency Insisted On.—The Indiana Public Service Commission has refused an application for increased rates made by the Rising Sun Water & Light Company because the utility failed to comply with orders of the commission with reference to improved service.

Small Plant Authorized to Discontinue Service.—The Illinois Public Utilities Commission has authorized discontinuance of service by the local utility in the village of Essex, where forty consumers and the municipality were formerly served, it being shown that the service, which had been furnished at pre-war rates, had already been discontinued on the expiration of a contract with the village, and no one making formal objection to the commission's approval of this discontinuance.

Jurisdiction of Arkansas Commission.—In granting an increase in electric rates to the Commonwealth Public Service Company of Fort Smith the Arkansas Corporation Commission announced its jurisdiction over the rates to be charged for electric service even where the property is in the hands of a receiver and pointed out that the regulation of rates by a commission, although these may be already fixed by a franchise with a municipality, does not cause an unconstitutional impairment of contract obligations.

Powers of Maine Commission.—The Maine Public Utilites Commission has, it asserts, no jurisdiction to refuse to approve a contract providing for the rendering of electric service to an applicant within certain territory where the contract is fair to both parties and no other company is authorized to do business in the territory in question, nor has it any authority to require or even advise one utility to purchase the property of another. The statutes of the state relating to monopoly are not enforceable through the commission, but only through the courts.

Good and Poor Territory.—The Public Service Commission of Washington holds that in fixing electric rates for a utility composed of an aggregate of widely separated power plants the economies of large production under common management and operation constitute a consideration of great weight. In determining the rate base for one community served by the Pacific Power & Light Company, which owns plants in both good and poor territory, the commission made an apportionment upon the basis of the demand in the different communities served.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Edward M. Graham, vice-president and general manager of the Bangor (Me.) Railway & Electric Company, was elected president on Feb. 9. When Mr. Graham in 1915 succeeded his

E. M. GRAHAM

father, the late John R. Graham, as the active operating head of the Bangor Railway & Electric Company, the Bangor Power Company, the Orono Water Company and the Bar Harbor & Union River Power Company, he was one of the youngest general managers to have charge of so extensive a property. The younger Mr. Graham gained his practical knowledge of railway and central-station management through an experience of several years under his father. He began his career with the Eastern Massachusetts Street Railway, at that time the Bay State Street Railway, which he served in various capacities. At the age of twenty-two years he was made superintendent of the Portland & Brunswick Street Railway and still later became assistant to the general manager of both the Lewiston, Augusta & Waterville Railway and the Cumberland County Power & Light Company, these being among the large public service corporations in Maine. Mr. Graham went to Bangor in 1913 as assistant to his father. He has been with the company there ever since. The companies of which he is now president and general manager operate electric railway lines in nine municipalities, in addition to providing sixteen cities and towns with light and power service.

John T. Kester has been appointed local superintendent of the Wabash Valley Electric Company, Sullivan, Ind., succeeding C. G. Hanna, who has accepted a position with the company at Clinton, Ind. Mr. Kester was formerly manager of the Noblesville (Ind.) Light, Heat & Power Company.

Dr. William McClellan, who was elected vice-president of the Cleveland Electric Illuminating Company nearly two years ago, has resigned that position to devote his time to his consulting practice. Dr. McClellan plans to take an extended vacation before entering upon active duties.

Jacob Hekma, secretary and treasurer of the Commonwealth Power, Railway & Light Company, Jackson, Mich., has been appointed vice-president of the company. G. H. Bourne, assistant secretary and assistant treasurer of the company, succeeds him as secretary, and George Sprague, Jr., has been appointed treasurer.

J. B. Crane, formerly with the Binghamton (N. Y.) Light, Heat & Power Company as construction superintendent, has become associated with the George T. Ladd Company at Pittsburgh. Mr. Crane in the past has been engaged in utility work with the Electric Bond & Share Company and the Great Northern Power Company of Duluth. He is widely known through the East and Middle West as a utility operator.

Major-General George O. Squier, Chief Signal Officer, U. S. A., has been

G. O. SQUIER

nominated by the President for reappointment. General Squier entered military service after his graduation from West Point in 1883 and has advanced by numerous promotions to his present post on account of his ability as an electrical engineer and officer.

Paul F. Williams, who has been selected to succeed H. B. Gear as engineer of distribution of the Commonwealth Edison Company, has been associated with its engineering work for twenty-three years. Mr. Williams was graduated from Purdue University in 1897 and upon leaving college received charge of the electrical construction work for a Wisconsin consulting engineer, part of this work being done in a branch office in Chicago. In 1898 he joined the staff of the Chicago Edison Company, the forerunner of the Commonwealth Edison Company, with which he has been connected ever since. His first position with the company

P. F. WILLIAMS

was in charge of interior-wiring inspection and distribution engineering in what is now the southern district of the Commonwealth Edison Company. He was brought into the general office of the company in 1900 as assistant to the general inspector. Upon reorganization and enlargement of the department in 1911 he was made assistant to engineer of distribution. Mr. Williams has taken out a number of patents on distribution apparatus. Based upon these patents, he created the G. & W. Electric Specialty Company, which he has successfully directed as president since its incorporation. Through this company's advertising and otherwise he was active last year in starting the "good-will" campaign as an aid to public utilities and electric manufacturers.

O. D. Mudgett, who for a number of years has been superintendent of the light and power division of the Androscoggin Electric Company, has received the same title and responsibilities under the new administration of the system at Lewiston, Me., from the Central Maine Power Company, George S. Williams of the latter company having succeeded F. D. Gordon as manager. Mr. Gordon is now general manager of the Cumberland County Power & Light Company, Portland, Me. Mr. Mudgett was assistant superintendent of the Lewiston & Auburn Electric Light Company from 1910 to 1914, when the Androscoggin company was formed, at which time Mr. Gordon became general

manager, Mr. Mudgett being appointed superintendent. Mr. Mudgett is a native of Gilmanton, N. H., and was graduated in electrical engineering from the New Hampshire State College. His early experience in electrical work was obtained at the Westinghouse factory in East Pittsburgh, Pa., and he was later attached to the Boston office of that company. He resigned to enter central-station work at Belfast, Me., in the organization of the Belfast Gas & Electric Company, now a part of the Central Maine Power Company's system.

G. E. Kimball, who has succeeded R. L. Eltringham as electrical engineer of the California Industrial Accident Commission, started his electrical experience in 1899 with the Queens Borough Electric Light & Power Company at Far Rockaway, Long Island, and in the shops of the Brooklyn Rapid Transit

G. E. KIMBALL

Company, Brooklyn, N. Y. In 1900 he was employed by the New Bedford and Fall River (Mass.) automatic telephone companies on line construction, telephone maintenance, telephone installation and as automatic exchange attendant. The exchanges in these two cities were the first automatic telephone exchanges of importance installed in this country. Entering the service of the Automatic Electric Company of Chicago in 1901, he was employed in the factory and the installation, engineering and experimental departments for a number of years. While in this service he was in charge of several large automatic telephone exchange installations. In 1910 he entered the service of the Bay Cities Home Telephone Company at San Francisco as superintendent of equipment and continued with that company until it was taken over and finally dismantled by the Pacific Telephone & Telegraph Company. Mr. Kimball remained in the plant department of the Pacific Telephone & Telegraph Company until 1917, when he became associated with the California State Industrial Accident Commission in the department of safety as state electrical inspector. He has been active in the administration of the general safety orders, electrical utilization safety orders and general lighting safety orders of this commission and in the formulation of the revised rules.

W. J. Hazel of the New York office of Robbins & Myers, Springfield, Ohio, has been transferred to the Canadian office of the company at Brantford, Ontario, where he will take up the duties of sales manager.

Charles Stirling, formerly assistant to W. J. Myers of the Robbins & Myers Company, Springfield, Ohio, has been appointed assistant manager of the Robbins & Myers Canadian factory at Brantford, Ontario.

W. W. Turner, who has been connected with the Chicago district office of the Elliott Company, Jeannette, Pa., has been appointed Chicago district manager to succeed C. L. Brown, who has been appointed sales manager of the company.

A. A. Hutchinson has been appointed manager of the Atlanta (Ga.) branch of the Combustion Engineering Corporation, 11 Broadway, New York City. Mr. Hutchinson was formerly with the Potomac Electric Power Company as construction engineer and superintendent underground testing department.

J. Allan Smith, president of the U. S. Light & Heat Corporation, Niagara Falls, N. Y., manufacturer of storage batteries, car-lighting equipment and electric arc welders, has resigned to engage in business for himself. C. O. Miniger, vice-president of the Willys Corporation and general manager of the "Auto-Lite" division of that corporation at Toledo, Ohio, has been appointed to succeed Mr. Smith.

H. L. Ball, who has been appointed sales manager of the Requa Electrical Supply Company at Rochester, N. Y., is well known in the jobbing field. For the last three years Mr. Ball has been with the Rochester Electric Supply Company as sales manager, and previous to that he was with the Westinghouse Electric & Manufacturing Company in a sales and engineering capacity.

J. L. Finnicum, who has been made sales manager of the Thordarson Electric Manufacturing Company, Chicago, was formerly connected with the Doubleday-Hill Electric Company at Pittsburgh for more than eight years in the capacity of salesman and in charge of the apparatus department. For the last two years he has been acting as district manager at Chicago for the Electric Products Company, Cleveland.

Allen A. Ransom, who has held the position of export sales engineer of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., has resigned to become associated with the Olympia (Wash.) Light & Power Company as general superintendent. He will also reopen his office as consulting electrical engineer for the Northwest and Alaska, specializing on hydro-electric and transmission projects, mining, dredging and irrigation work.

Fred A. Scheffler, who was elected president of the Edison Pioneers at its annual meeting on Feb. 11 at the home of Thomas A. Edison, is a well-known pioneer of the electrical industry. He became associated with Edison in 1881 and as engineer designed for him the second electric locomotive built for experimental purposes at Menlo Park, N. J. Later Mr. Scheffler held such important positions as those of general superintendent of the Westinghouse Electric & Manufacturing Company's works at East Pittsburgh, general superintendent of the Brush Electric Company, Cleveland, and manager of the Sprague Electric Company's factory, Watsessing, N. J. Mr. Scheffler was also connected with the introduction of the Stirling type of boiler manu-

F. A. SCHEFFLER

factured by the Babcock & Wilcox Company. He is now general manager of the Fuller Engineering Company in New York City. He has the rank of fellow in the American Institute of Electrical Engineers and is a member of the American Society of Mechanical Engineers and the Engineers' Club, New York.

Obituary

Oliver Wolcott, for about ten years past superintendent of the Worcester Suburban Electric Company, with headquarters at Uxbridge, Mass., died suddenly on Feb. 7.

James C. Legg, a member of the Public Service Commission of Maryland and former president of the Baltimore Chamber of Commerce, died Feb. 1 in Baltimore from pneumonia.

Charles N. Wurth, an electrical associate of Thomas A. Edison for about forty years, died recently at his home in Orange, N. J. He was born in Switzerland in 1841.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Competition, Not the Inauguration, Will Fetch the Business

BEFORE another week shall have gone by a new administration will have been installed at Washington. It is difficult to conceive, however, how this could greatly affect the present business situation as some have expected. Four months ago it was known that the nation would undergo a change in the politics of its administration, and there has been plenty of time for this certain event to be discounted.

As a matter of fact, it is clearly evident that the old law of supply and demand is still in control. The new administration will undoubtedly inspire in business a certain confidence that no detrimental legislation will be enacted, but more than that is needed to make business healthy again. Generally speaking, business has been better in February than it was in January, and March will probably show a similar improvement over February, and so on until business once more becomes satisfactory. In the meantime everything is being done, in some cases more or less hastily, to bring down costs. Wages are still coming down, and, as was to be expected, individual productivity is increasing.

Signs of competition are becoming more frequent. There has not been enough competition, however, to make it an asset to business. There is still too much sitting back waiting for the storm of depression to blow over. Good, strong, honest competition for orders would undoubtedly stir up a whole lot of trade.

Business is more or less like a boxer in its nature. For five years it has lived on the fat of the land and taken no exercise; it has grown fat and pudgy. Business must now go out and fight for a living once more. It therefore must train, and the exercise is called competition.

There is a lot of business to be done before many months are gone. This business will not come of itself to the manufacturer or jobber. He must go find it.

Outlook for Early Steel Revival Not Favorable

STEEL and iron, two of the fundamental factors in this nation's industry, were discussed before the Editorial Conference in New York on Feb. 18 by A. I. Findley, editor of *Iron Age*. In his address, Mr. Findley said in part:

"What is certain is that the steel trade is today in a depressed state and that those who in November looked for a moderate revival in the spring of 1921 are now setting the date for any marked improvement some months further on in the year. There is a growing belief that present conditions in the United States are due more than we were willing to believe last year to the financial and industrial straits of Europe. As never before, leaders in industry and finance in this country see that we are linked up with the rest of the world for better or worse.

"In view of its basic character, developments in the steel trade are important as an index to what is to be expected in 1921. Today there is about two-thirds operation of iron and steel works, with the possibility that with the coming of spring a temporary spurt in demand may bring the percentage up to 75. It has been found in other times of depression that wear and tear alone is good for about a 60 per cent operation in iron and steel.

"The outlook for an early and extensive revival of demand for iron and steel is not favorable. The fall in prices of agricultural products, which already represents a loss of $4,000,000,000 to the farming community, has reduced very much the demand for agricultural improvements. The railroads, which in average times take from 20 to 25 per cent of the steel output, are buying little. Rails and track accessories have been in best demand in the forms of steel which go to railroads. Until the railroads are freed from the stranglehold of the wasteful labor scheme imposed on them by the government they will not be free buyers of equipment. Today they have many idle cars with no early prospect of full use of their equipment.

"That the country is much underbuilt has been said over and over in the past two years. The automobile building program for 1921 can hardly be more than 40 per cent of that for 1920. The automobile industry has probably not taken more than 5 or 6 per cent of the country's steel output on the average, but its ramifications into various metal-working and machinery lines are such that it has been a very important sustaining factor. Shipbuilding demand for steel in 1921 is likely to be considerably less than in 1920. Mining, whether of coal, iron or non-ferrous minerals, will be restricted in 1921. So far as iron, copper and other metals are concerned, operations of the mines this year can hardly go beyond 60 or 70 per cent of last year.

"The most favorable indication industrially for the present year is the evidence of a return to economic production methods. It will be a good thing for producers to learn again how to sell their products."

Fixture Manufacturers Act to Stop Design Piracy

MUCH attention has been given in the past year or two by the fixture manufacturers to the question of design piracy in the lighting fixture field. The practice has become so objectionable that the National Council of Lighting Fixture Manufacturers, in convention at Buffalo last week, passed a resolution in an endeavor to curb it and finally eliminate it.

A committee of this council prepared a set of resolutions which, with three additions, was adopted by the council for incorporation in the bylaws of the council. Without reproducing the form of the resolution here, it provides for the appointment of a board of conciliation empowered by the council to review and pass upon all questions of piracy and to impose such penalties as it deems justified. Its action is considered final except that recourse may be had to the courts.

Where the controversy is purely local it may be handled by a local arbitration committee, from which appeal to the national council may be made. All opportunity is given to both parties to present witnesses and evidence, but failure to answer the complaint within a specified time brings the conclusion that the charges of the complaint are justified.

In all cases the cost of arbitration shall be borne by the party against whom the judges decide. The penalties to be imposed shall be (a) reprimand and demand for apology, (b) suspension from the association, (c) suspension of rights such as the right to exhibit at the annual fixture show, etc., (d) expulsion from the association, (e) publishing the decisions of the board in the *Lighting Rays*, etc., (f) cost fine, (g) disposition or destruction of infringing parts of fixtures, patterns, molds, etc., of the offending party.

Recommendation is made that there will be an attempt to settle personally any difference that may appear when a manufacturer believes he has a case of piracy against any other member of the association.

The council believes it should take an active part in any attempts to protect designs of its members and stop infringement. Of course, all patentable designs could be patented, but the cost would be enormous, and the cost necessary to protect them would also be enormous. At the same time, it is thought that questions of design patent can be discussed and judged more accurately by members of the council than by the legal courts.

Industrial Reflector Sales Expected to Increase

SALES of industrial reflectors show considerable falling off when compared with a few months ago, but at the same time a fairly good current volume of business is being done by many of the large manufacturers, according to reports received from them. This demand does not come from new buildings, for construction work is still at a low ebb over the country, but from existing plants that are revamping their old lighting equipment and installing up-to-date systems. One of the most recent developments in industrial lighting is a luminous-top reflector having a neck of opalescent glass, for use in locations which demand that a portion of the light be directed upward.

Excellent prospects for a good year's business are seen by nearly all manufacturers. Growing interest in better lighting, campaigns of education to teach the benefits of efficient illumination, and a resumption of building work along with general trade are all expected to contribute to this end. Just when a noticeable increase in sales may be looked for is uncertain, but producers for the most part anticipate an increasing demand some time between the first of March and the first of April.

Prices remain stationary, and there is virtually no possibility of any decrease being made, it is said, at least during the present lighting season. About the only item in the manufacture of reflectors which now costs less is that of steel, and this represents a very small proportion of the finished-product cost. Some manufacturers will even be working on high-priced stocks of steel until first-quarter shipments of this material are made about the middle of March.

Production is going right ahead in several instances in an endeavor to accumulate surplus stocks. The reserve supply now on hand at factories and distribution points is sufficient to insure prompt deliveries, shipments of most types being made either from stock or close to it. On the other hand, reserve stocks are not very large because raw material previously held back production to such an extent that orders fell far behind. These orders have only just recently been caught up with.

Bright Prospects for Farm-Lighting Plant Sales

MANUFACTURERS of farm-lighting plants see only good prospects for sales in the year to come. Optimism is widespread regarding future business, and the view is generally heard that 1921 will be a better year than 1920. The basis for this opinion is not the present market, however, as demand has been on the decline for some months, though there is still a fairly good current amount of new business.

Farmers in the West and the South have been especially hard hit in their buying power because of the price slump in cotton, tobacco and wheat and the necessity of carrying loans on their products. This condition should improve, it is said, but even at present, although it is harder, it is by no means impossible to make sales in those sections. Vigorous sales methods and campaigns of education are being planned by some producers to push their product in the spring.

In preparation for this producers are generally manufacturing plants for stock. As a consequence immediate delivery is quoted on present orders, though reserve stocks on hand are as yet only fair. Price reductions have been made by several manufacturers. The price sheet of one producer, dated Feb. 15, quotes reductions which range from 12 to 27 per cent, covering seven different plants. The new prices are guaranteed against a reduction until July 1. Another producer announces that a general price cut of 10 per cent will be made on March 1, while a third has only lowered quotations on two types, and that but a very small amount, such as $10 on a six-hundred-dollar power plant. Not all manufacturers have reduced prices, however. One of the largest makers of this product has not altered quotations and so far as can be learned has no intention of doing so, inasmuch as costs, including labor, are said to be no lower.

No Blanket Action Against Price Guaranteeing

THE Federal Trade Commission on Feb. 15 announced that it intends no blanket action against the practice of guaranteeing against price decline, but will consider each complaint upon the facts shown in the specific case. Any blanket order would have had considerable effect on many electrical manufacturers. The announcement says:

"The commission received so many complaints about the practice of manufacturers in guaranteeing commodities in the hands of wholesalers against decline in price that an extensive inquiry was made, resulting in expressions from more than 350 manufacturing and selling concerns, including trade associations whose represented membership must be more than double the number of individual statements. From the scope of the inquiry and the number and variety of replies, the result shown must be taken to be fairly representative of the difference in business opinion on this subject.

"The Federal Trade Commission, therefore, will consider each case of complaint of this character upon the facts shown in the specific case, applying the legal tests thereto. This action involves neither approval nor disapproval of the economic soundness of the arguments advanced before the commission for and against this practice."

The Metal Market Situation

LARGE copper producers claim to be holding to their price of 13 cents delivered, but this quotation is entirely nominal and probably adhered to for the moral effect which a substantial price drop would have upon the marketing of the $40,000,000 bond issue recently placed. Sales have been made under 13 cents, however, as low a price as 12.50 cents being taken this week. Consumers are showing little or no interest in buying. The outside market remains stagnant too, and foreign buying, which had taken a slight turn for the better recently, especially from Germany, has turned very weak. Premiums of about ⅛ cent per month are asked for forward delivery.

The price of lead has again been reduced by the leading interest, this time to 4.40 cents per pound. Demand continues light, though some sales have been made on the decline. Zinc presents a listless market, spot declining a fraction of a cent the past week.

NEW YORK METAL MARKET PRICES

	—Feb. 14, 1921—	—Feb. 21, 1921—
Copper	£ s d	£ s d
London, standard spot	71 0 0	72 5 0
	Cents per Pound	Cents per Pound
Prime Lake	13.50	13.25
Electrolytic	13.00–13.25	12.50–12.75
Casting	12.50	12.37½
Wire base	15.75	15.75
Lead, trust price	4.75	4.40
Antimony	5.25	5.20
Nickel, ingot	43.00	41.00
Sheet zinc, f.o.b. smelter	11.00	11.00
Zinc, spot	5.37½	5.30
Tin	33.50	32.50
Aluminum, 98 to 99 per cent	28.00	23.50–24.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	11.00–11.25	10.75–11.25
Brass, heavy	6.00– 6.50	7.00– 7.50
Brass, light	4.00– 4.50	4.00– 4.50
Lead, heavy	4.00– 4.12½	3.75– 4.00
Zinc, old scrap	3.00– 3.25	3.00– 3.25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

THE return to better conditions in the jobbing trade seems to be holding its own with no noticeable spurts noted. Buying is quiet from jobbers, while they on their part are only keeping up to the trade's demands in respect to their own buying.

More important price cuts have been announced this week, taking in fans, farm-lighting plants and further copper, motor and controller parts and armature and field coils. Shipments are likely to be delayed somewhat by the snowstorm of Feb. 20, which was quite general throughout the East.

Wage reductions are becoming more general and are causing little difficulty. Among the recent companies affected is the Westinghouse Electric & Manufacturing Company, in Pittsburgh, where a 15 per cent reduction will go into effect March 1.

NEW YORK

The optimistic tone to trade persists despite the fact that business comes only by fits and starts. Some jobbers, however, report slightly better sales all along the line. A few can detect no improvement, and still others state that the market is not consistent, but picks up one week only to decline the next. A general return of building construction work seems to be badly needed to provide a stimulus to wiring lines. This as yet remains lacking. Demand for heating appliances is poor and overstocks are frequent.

Jobbers are ordering goods only for replacement of current stock, and a thirty-day supply seems to be the most that is willingly carried on staple lines. Competition is very keen, and consumers who shop diligently are generally able to obtain shaded prices. Prices remained steady this week on most items so far as manufacturers are concerned. Collections still range about sixty days, but one or two jobbers report quite a decided improvement in the situation.

Flexible Armored Conductor.—Some improvement is noted in the slow market, though not a general one. Stocks are down to fairly low levels. From $60 to $66 per 1,000 ft. is asked for No. 14, two-wire, double-strip.

Metal Molding.—Demand seems to be very light, while the supply is plentiful. The three-wire and four-wire size brings from $67 to $70 per 1,000 ft.

Safety Switches.—Jobbers are carrying only a limited number in stock as the call is not large.

Conduit.—Stocks are more than ample for demand, which is light on the whole, though fairly good in a few instances. In 2,500-ft. quantities ½-in black is selling for from $70 to $76.50 this week and ¾-in. black from $92 to $101 per 1,000 ft.

Rubber-Covered Wire.—Some jobbers are making fairly good sales to industrials in small lots, but total demand is not great. Overstocks are still reported. No. 14 is sold as low as $7.50 and up to $9 per 1,000 ft. in 10,000-ft. lots.

Fuses.—The market for fuses is rather quiet now, and though normal stocks are on hand sales are slow. On the standard N. E. C. non-renewable type, 250 volt, 30 amp., jobbers are quoting from 10 to 11 cents each in standard-package quantities, though prices as high as 14 cents have been asked in one or two cases.

Porcelain.—There are plenty of knobs, tubes and cleats to be had, but sales are slow. In barrel lots "Nail-it" knobs are priced from $27 to $32 per 1,000, 3-in. x ⅝-in. tubes at $9.65 to $13.75, and two-wire unglazed cleats all the way from $21 to $34.

Schedule Material.—The market is quiet in this line, and jobbers are freely interchanging stocks to reduce surplus supplies which exist in many cases. These overstocks are growing less, but it will be some time before buying is other than hand-to-mouth.

Heaters.—The winter has been a poor one for sales, and jobbers with low stocks congratulate themselves. Overstocks are numerous, as many as 2,500 heaters being carried by one jobber. Price cuts have been made, especially in the retail trade, some dealers offering standard makes under $9.

Fans.—A reduction in price of 10 per cent has been applied on fans—portable, ceiling and exhaust—by several manufacturers effective early this week.

CHICAGO

Sluggishness throughout the entire industry continues to be the dominant feature. This is true of practically all lines in this region, although the industrial depression seems to be less marked here than in other sections. Electrical stocks are being permitted to run low, jobbers being content with a thirty-day supply of most items, while retailers and contractors are refusing to order until the bottom of the bin is in sight. Recent cuts in a broad range of electrical goods have actually worked to accentuate this disposition, as all hands seem determined to avoid any loss on stocks should further reduction occur.

The building situation shows promise of improvement. Last week a permit was taken out for the new seven-and-a-half-million-dollar Federal Reserve Bank, and in addition $1,000,000 worth of small jobs was initiated. Special loan offers are being made by banks, and various co-operative schemes are being planned. Non-employment remains a feature. Many men are out of work and wage scales are being reduced. Employment in the building trades is reported as aggregating less than 50 per cent of normal.

Bare Copper Wire.—Leading jobbers quote all sizes up to No. 8, in small quantities, at 18½ cents per pound. Carload lots are quoted over quite a range, $16.50 being a representative figure.

Insulated Wire.—Uncertainty prevails in prices on all items in which copper enters very largely. Weatherproof, triple-braid, No. 8, in lots of 500 lb., is quoted at $20.50 per 100 lb.; No. 6 at $20. No. 14 rubber-covered in 10,000-ft. lots is $7.85 per 1,000 ft. Flexible armored conductor, two-wire, No. 14, is priced at $62 per 1,000 ft., in 5,000-ft. lots or larger. Sales are quite lively, and some price cutting is indulged in.

Black Conduit.—The market is quiet, prospective buyers apparently being uncertain as to the future price trend.

Poles.—In spite of general reductions in the electrical field and in the wood-products field, prices are held firm. Opinions differ, producers saying that short season and long haul have completely offset the saving effected by lower-priced labor and slight weather interference.

Line Hardware.—A leading interest announces an additional 7½ per cent cut on all items on the list. No heavy buying is in evidence. It seems possible that prospective buyers are holding off to such an extent as to endanger their own welfare.

Insulators.—Prices on both glass and porcelain insulators are firm and unchanged. Stock conditions on small sizes are improving, but large sizes remain hard to get, four to five months still being the best delivery obtainable.

Power Apparatus.—Manufacturers and jobbers state that business has been so quiet for the past six weeks that it is hard to tell whether or not the recent 10 per cent price reduction has had any effect on the trade. Inquiries are scarce and orders more so. Small dealers continue to shade prices.

Control Apparatus.—Previously mentioned cuts in certain items have not become general. Those lines which have reduced prices report no change in the condition of business—inquiries fairly plentiful but orders scarce.

BOSTON

Little change appeared at the beginning of the week in trade conditions in New England. Inquiries are coming into jobbers' offices in somewhat greater volume, while actual sales are spotty and largely confined to orders for immediate necessities. Stocks are being liquidated to a point where real shortages are beginning to appear in some cases, one of the prominent Boston jobbers being cleaned out of certain wiring supplies at the end of the week. It is not difficult for buyers, however, to get material, with the exception of porcelain insulators and meters. Prices held pretty firmly throughout the week past between manufacturers and jobbers, but unstable conditions are evident in the retail trade, prices being based mainly on the size of local stocks. Collections are responding to vigorous follow-up efforts. Building and engineering contracts for the week ended Feb. 15 in New England totaled $1,387,300. The Boston building strike continues to impede progress in local wiring jobs and to reduce the sale of wiring supplies.

Rubber-Covered Wire.—Good stocks are in hand, and in order to move this material a reduction to $8 per 1,000 is being made on 5,000-ft. lots. This is increasing the size of orders, in view of the existing opinion that wire is unlikely to go much lower at present.

Insulators.—Inquiries are active and an early increase in buying is forecast. Deliveries are running long, a representative distributer quoting six to seven months on new orders. Foreign shipments are absorbing a considerable output of the later designs of high-tension material. Emergency requirements are being met on this side, but stocks are very low and prices are reported firm.

Flexible Armored Conductor.—Good-sized stocks are still on hand in many warehouses, although these are gradually being lowered. No. 14 double strip sold at $63 to $65 at the week end.

Lamps.—A healthy trade is being handled with excellent deliveries. Portable lamps are moving rather slowly, accompanied by price variations in retail quarters. Sign and window display lighting is active, and the development of new applications of low-powered illumination continues to expand the market for lamps of small size.

Washers.—Sales are continuing at a fair rate. Deliveries are prompt and jobbers are paying close attention to service.

Vacuum Cleaners.—Liberal stocks are in sight in both wholesale and retail establishments. Prices vary widely in the latter between different makes of cleaners, and conditions cannot truthfully be called stable as yet. The public is responding somewhat to vigorous personal sales efforts.

Irons.—Fair sales are being made, but buying is not up to normal.

Radiators.—Protracted mild weather for this season, a leading agent predicts, will result in large spring sales. Interest has been sustained in these devices throughout most of the winter. Prices held firm to the week end.

ATLANTA

The little spurt in jobbing activities reported last week seems to have spent itself, and firms report business for the past week rather slow, though there has been some activity in certain lines. Nevertheless, the underlying opinion is that the business outlook continues to improve. Official figures recently announced give the value of crops in the eight Southeastern states at approximately $2,000,000,000, serving to indicate that there is plenty of wealth in the section and that activities are only awaiting the willingness of the country to take some of the products on hand. The Federal International Banking Company went into operation the first of last week and announces that its total loan facilities of $17,500,000 have already be absorbed on goods destined for export.

Jobbers report the receipt of a fair number of inquiries for moderately heavy bills on goods, most of the inquiries coming, however, from industrial plants scattered throughout the section. Central stations and municipalities are also making inquiries for small lots, but contractors are buying on a hand-to-mouth basis. Collections continue rather unsatisfactory, especially from contractor and automobile classes.

Poles.—The movement of poles has materially slowed down in the past two weeks, and few orders are being received. Southern white cedar poles seem to be more in demand than heretofore owing to their low price. Stocks are heavy and no difficulty is being experienced in obtaining cars.

Conduit.—Conduit is moving rather slowly, though fair orders are reported from time to time. Stocks of galvanized show a shortage in 1-in. and 1¼-in. sizes. Stocks of black are somewhat spotty.

Industrial Lighting.—This line is fairly active, the more stable industrial plants having indicated their intention to improve their lighting facilities. An expectation of price reductions, however, is tending to hold up buying by consumers. Stocks are in splendid shape.

Flexible Armored Conductor.—The desire to cheapen construction as much as possible has created a demand for this material, and all jobbers report their sales as fairly good. Stocks are in good shape and shipments are good. Price, two-wire, No. 14, single-strip, $72 per 1,000 ft.

Heating Appliances.—There are very heavy supplies of heating appliances throughout the section, stocks of flat-irons being particularly large. Little or no movement is reported in this line, with the exception of irons, hollow ware being very slow indeed.

Lightning Arresters.— Manufacturers report a fairly active demand for high-tension arresters. Shipments are running from thirty to sixty days.

Meters.—For the first time in several months the jobbers and manufacturers' agents have been able to accumulate small stocks of watt-hour meters in the more popular sizes. While the largest jobbers report the volume of orders about 30 per cent below that of last year, they expect a revival in this line within the next sixty days. Shipments on two-wire and three-wire, 5 amp. and 10 amp., in the 110/220-volt type, are averaging about two weeks.

ST. LOUIS

Sales continue fairly strong and, judging by the average maintained during the past two weeks, February will run ahead of January in orders billed. Orders, it is true, are mostly small, but it is noticed that numbers of industrials which have been out of the market for some months are re-entering it again.

Non-employment is becoming less general. Several steel plants in the St. Louis industrial district have reopened within the last few days on a part-time basis. Automobile plants are augmenting production, encouraged by the success of the automobile show held in the first part of February. The peak of the non-employment situation is thought to be past and labor costs have dropped in most instances. Wages of the building trades are still high, though efforts are being made to lower the scales in force. It is agreed that this would give reality to a large number of building projects now only on paper.

Stocks of electrical supply houses are becoming less top-heavy and are down to normal on a number of items. Prices are holding well in most lines, but concessions on porcelain are very noticeable and are having a demoralizing effect. Collections are becoming better, one large jobber reporting an average of fifty days, while the general average is close to sixty days.

Non-Metallic Flexible Conduit.—Quotations vary, but the average would seem to be around $22 per 1,000 ft. of ¾-in. conduit and $25 per 1,000 ft. of the 1-in. size. Sales are light, but jobbers have not been ordering recently and the steady though slow demand has brought stocks close to normal.

Insulators.—Stocks are good on all but the largest sizes of porcelain insulators, and deliveries can be made out of stock except on the latter, delivery on which is being promised in five to six weeks. One large jobber has on hand a three to four months' stock of porcelain insulators under the 66,000-volt size. Supplies of glass insulators are ample to take care of demand, which is running along well.

Rigid Conduit.—The demand for the ½-in. and the ¾-in. black iron conduit has increased noticeably during the past

week, before which sales had been almost negligible. Stocks of all sizes are good, those of the larger sizes being heavy. Prices are firm. The ½-in. black is quoted at $77 per 1,000 ft., and ¾-in. at $102, and the 1-in. at $150, all in lots of 5,000 ft.

Rubber-Covered Wire.—A fair demand has continued during the past week, though orders are individually small. Stocks are getting down to normal in the popular sizes. Prices have not changed, No. 14 being quoted around $8 per 1,000 ft., in 5,000-ft. lots.

Lamps.—There has been no drop in sales, which have been good all through the winter. Stocks are complete and conditions in general, as far as the distributors are concerned, have been normal.

Motors.—Orders are slow. Manufacturers have about caught up on all back orders and can ship most sizes out of stock or make normal deliveries on special sizes and types. Supplies of fractional-horsepower motors are ample to take care of all demand. Prices are on a level about 10 per cent lower than they were in January.

Dry Cells.—Demand continues fair with stocks easily capable of taking care of it. Prices are firm, the No. 6 cell being quoted at $36 per 100 in barrel lots.

Hollow Ware.—Jobbers report steady sales after a slump which prevailed during the first half of January. The remainder of that month brought good sales, and February sales will show an increase. Stocks are generally good. Retailers are fairly well supplied but are ordering from jobbers in good quantities.

SAN FRANCISCO

The prevailing note is more optimistic. Building is a little better and the buying public is in a more reasonable state, there being less talk current about awaiting slashing reductions.

Motors.—Excellent deliveries are now being made on motors for the first time in several years. This has produced rather high jobbers' stocks, but the sales are good. Many farmers have postponed the purchase of pumping plants, and the heavy rainfall which will naturally cause a decrease in orders for motors is more than compensated for by power extension, especially in the San Joaquin Valley.

Vacuum Cleaners.—The prices on vacuum cleaners have remained steady. Canvassing is providing the bulk of the present sales, but local stocks are high and business is much quieter than at this time last year.

Schedule Material.—Local manufacturers' stocks are good but not excessive. Orders from jobbers and dealers alike are numerous but of minimum quantities. However, some manufacturers are even now placing big orders in expectation of a forthcoming break in the present small-order hand-to-mouth conditions. Heavy porcelain pieces, such as panel switches and cut-outs, are of slow factory delivery because the producing pottery factories are being reorganized and are apparently suffering from underproduction. Some manufacturers are also reporting a temporary shortage of porcelain key sockets.

Heating Material.—Strenuous selling efforts are producing a better demand for flatirons and small stoves, but jobbers' orders for other devices, especially hollow ware, are very low because of heavy stocks carried forward. Sales of radiators are tapering off rapidly toward the close of the cold season. Especially noticeable are the recent efforts of dealers to maintain well assorted and arranged stocks of heating-piece parts.

Weatherproof Wire.—Weatherproof base sizes in triple-braid are now being quoted at 22½ cents per pound.

Tape.—In looking over jobbers' tape stocks it is found that they are fairly heavy, although they would have been more so had not the size of the factory orders been reduced, because dealers are buying in smaller lots. Construction is decreasing, and for the next month or so at least it is felt that it would be unwise to purchase heavily. This drop in demand figures from 20 to 30 per cent in friction tape. Rubber-tape stocks, however, are rather low.

SEATTLE—PORTLAND

With the exception of a slight increase in sales of schedule material, tape, wiring devices and other material used in building construction, conditions in the Puget Sound district and in Portland show no particular change. Stock conditions are improving and prices, with the exception of wire, tape, etc., are holding. Logging camps and lumber mills are reopening slowly, but the major portion are operating on only a three-day week. It is believed this condition will obtain for at least thirty days. Surplus labor is being absorbed very slowly and the non-employment situation is still very acute.

Manufacturers and jobbers report that there is no improvement in business. There is a report that buying is very short and that customers who formerly bought in standard-package lots are now buying in unit-package quantities. Those who formerly bought unit packages are now buying broken-package assortments; showing a determination to buy only for actual present needs. Jobbers' stocks are naturally getting into excellent shape. About the only thing that is appreciably short, especially in the Portland district, is certain sizes of galvanized conduit.

Generally speaking, the credit situation in both Seattle and Portland is unchanged and money is not yet free. Warehouses are still full of last year's salmon pack because of lack of demand at what is considered desirable prices. For the same reason the fruit packers in eastern Washington and the Willamette Valley are still holding the 1920 crops. The farmers in these sections are also holding their wheat and other grains. Warehouses are full of wool with no market, and there is little demand for lumber. This naturally means an enormous amount of money tied up in commodities which are not moving and until some of these move appreciably much improvement cannot be expected in the way of obtaining ready money for financing new projects.

Tape.—Stocks are normal, and there is plenty on hand to meet current demand. No difficulty is being experienced in securing replenishments. During the past month demand has picked up appreciably, and from present indications, with increasing activity in new construction, it will continue on the increase. Friction tape, ¾-in., as well as certain special sizes, has dropped several times since the first of the year, and further reductions would not be unexpected.

Ranges.—Demand continues falling off, and from present indications this spring's demand will be far less than for several years past. Stocks are in good shape, but prices are considered too high, coupled with heavy installation charges.

SALT LAKE CITY—DENVER

One of the outstanding features of the business situation in the Intermountain region is the demand for loans in large and small amounts. It is taken as an indication that trade will hit a swinging stride as soon as the credit condition has sufficiently eased. Banks are still ultra-conservative in granting loans for any except the most promising projects. A mild open winter has decreased the demand for money on the part of sheep and stock men. Operating expense has been materially cut down and the request for credit reduced accordingly. The banks have thus been in a position to take better care of all who use credit. The investment market is showing a healthy increase in activity, with a steadily growing demand for high grade securities. The sugar situation, which has been passing through a critical period, shows marked improvement. The tendency of the federal government to favor protective tariffs has created a decidedly better morale among beet growers. Many sawmills that have been closed down for months are reported resuming operations, an indication that owners are confident that building and construction work will be revived in the near future. Building material prices continue on the downward trend.

Washers.—The demand is showing a steady improvement. Dealers are preparing for the annual spring drive and are stocking. Manufacturers are in a position to keep their jobbers amply supplied.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Westinghouse Takes Agency for Electric Furnaces

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces that it has been appointed exclusive sales agent in the United States, its possessions and Canada for the line of industrial type "Hevi-duty" electric furnaces manufactured by the Electric Heating Apparatus Company, 123 Sussex Avenue, Newark, N. J. The standard heavy-duty industrial furnaces include twelve different sizes from 18 in. wide, 24 in. long, 13½ in. high, inside dimensions, capacity 22 kw., up to 32 in. wide, 72 in. long, 16 in. high, capacity 80 kw. Either automatic or non-automatic temperature control is supplied.

Year's Fuse Tests Run Into Big Numbers

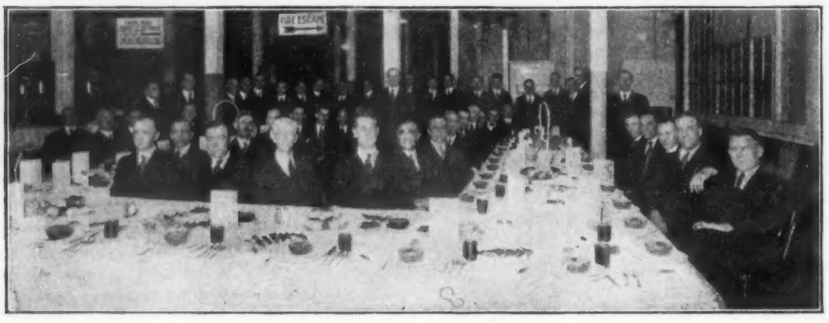
During the past year short-circuit tests on 6,795 cartridge-inclosed fuses were made by the Underwriters' Laboratories, Inc., at its New York City station, according to its January *Laboratories Data*. This number was evenly divided between 250-volt and 600-volt fuses, but approximately twice as many renewable as non-renewable fuses were tested. As high as 566 were tested in a single day. A large number were also tested at Chicago.

Follansbee Brothers Company Issues $4,000,000 Bonds

A new issue of $4,000,000 of first mortgage, twenty-year, 7 per cent sinking-fund gold bonds, dated March 1, 1921, is being offered by Follansbee Brothers Company, Pittsburgh, Pa. Electrical sheet steel is one of the company's products. The proceeds of this issue, together with an additional $1,000,000 realized from the proposed sale of $1,000,000 par value of common stock, will be used to retire an issue of $1,500,000 cumulative preferred stock, to complete the manufacturing plant at Toronto, Ohio, and to provide additional working capital. The issue is in denominations of $1,000.

Officials of the Arrow Electric Hold Banquet

The Arrow Club, composed of the officers and heads of the departments of the Arrow Electric Company, Hartford, Conn., held a banquet on Feb. 1, at the factory. The gathering was a success not only from the standpoint of entertainment but also because of the spirit of optimism which prevailed.



ARROW ELECTRIC DEPARTMENT HEADS AND OFFICERS MEET

Northern White Cedar Association Elects Officers

At the twenty-fifth annual meeting of the Northern White Cedar Association at Minneapolis on Feb. 8 and 9 Benjamin Finch of Duluth was elected president, W. B. Thomas of Manistique, Mich., vice-president, and H. F. Partridge of Minneapolis treasurer. M. H. Schussler and W. C. Meader of Minneapolis were appointed directors to serve two years.

Ryan Company to Specialize in Electrolytic Work

F. J. Ryan & Company, Franklin Trust Building, Philadelphia, specialist in electric heating problems in both the chemical and metallurgical industry, announces the appointment of departmental executives: S. H. Ourbacker, director of engineering; F. A. Hall, director of sales, and T. B. Bechtal, director of construction. From this time on the new organization will specialize exclusively in electrometallurgy and electrochemistry. Departments for the manufacture of its own low-temperature ovens have been added and structural and machine divisions created through associations with Philadelphia shops. The company has recently opened a New York office at 21 East Fortieth Street under the direction of E. C. Melby, who will have supervision over the New York district and export field.

Jefferson Glass Erects New Gas Producers

During the past twelve months the Jefferson Glass Company, Follansbee, W. Va., has greatly enlarged its factory space and has also improved factory conditions by the erection of new gas producers and muffled lehrs, which, according to C. H. Blumenauer, president, will not only improve the quality of the company's products but also effect a relief from the results of natural-gas shortage during the winter.

Note Issue to Finance Copper for Foreign Market

The Copper Export Association, Inc., has issued $40,000,000 in one, two, three and four-year 8 per cent secured gold notes in denomination of $1,000. These are secured by 400,000,000 lb. of refined copper, and the sums required for payment of principal and interest, it is reported, will be guaranteed by seventeen of the leading copper producers in this country. The Guaranty Trust Company of New York is trustee. All of this copper, it is announced, has been purchased by the Copper Export Association, Inc., for resale in foreign markets, from these seventeen companies: Anaconda Copper Mining, Calumet & Hecla Mining, United Verde Copper, Chile Exploration, American Smelting & Refining, Inspiration Consolidated Copper, Greene-Cananea Copper, Braden Copper Mines, Utah Copper, Ray Consolidated Copper, Chino Copper, Nevada Consolidated Copper, New Cornelia Copper, North Butte Mining, Utah Consolidated Mining Company and the Phelps Dodge and Kennecott Copper corporations.

Woodworking Machinery Maker Enters Motor Field

The S. A. Woods Machine Company, Boston, for years manufacturer of the "planers of woods," has added a motor department and developed a line of 5-hp. general-purpose induction motors —squirrel-cage, polyphase, double-rated, semi-inclosed, with 40-deg. ratings. This department is in operation now and will soon be in position to manufacture on a large-scale basis.

Toledo Crane Company Enlarging Plant

The Toledo Crane Company, Bucyrus, Ohio, successor to the Toledo Bridge & Crane Company, Toledo, manufacturer of "Toledo Cranes," has been chartered under the laws of Ohio. The company is now constructing and expects to have completed by March 15 a building, 120 ft. x 320 ft., to be used for erecting and assembly purposes; machine shop, 60 ft. x 300 ft.; structural shop, 90 ft. x 300 ft.; pattern shop, 60 ft. x 140 ft., all equipped with modern tools and arranged for continuous production, which

will enable it to maintain former standards of quality and service established for "Toledo" cranes. The main office of the company will be at Bucyrus, with sales offices in New York City, Boston, Philadelphia, Pittsburgh, Buffalo, Cleveland, Cincinnati, Chicago, St. Louis, Kansas City, Seattle, Salt Lake City, San Francisco, Birmingham and Minneapolis. C. F. Michael is president and W. F. Billingsley is vice-president and general manager.

Moorhead Laboratories Closes Contract for Vacuum Tubes

The Moorhead Laboratories Company, San Francisco, which operates one of the largest factories in the world devoted exclusively to the manufacture of vacuum tubes, recently closed a contract with the Radio Corporation of America, the General Electric Company and the American Telephone & Telegraph Company whereby it will continue to manufacture vacuum tubes under the Fleming valve and De Forest audion patents. These patents are controlled by the General Electric Company and the American Telephone & Telegraph Company.

Wilson Acquires Wescott Jobbing Business

The electrical jobbing business of George T. Wescott & Company, 645 Washington Boulevard, Chicago, has been taken over by Gordon D. Wilson, who will continue to represent the following companies under his own name: The Scranton Button Company, manufacturer of composition socket bushings, insulation material, etc.; Triangle Conduit Company, "Triduct" flexible non-metallic conduit, "Tricord" portable conductor for hard service, etc.; Dongon Electric Manufacturing Company, bell ringing transformers, ammeters; Fibro Products Company, electrical and mechanical tubes; Scranton Glass Instrument Company, battery thermometers, etc., and the D. M. Steward Manufacturing Company, "Lavite" insulators.

Contests Among Lamp Operatives Increase Production

"Ballot-box battles" have been waged among operatives of both the large lamp factories and miniature lamp factories of the National Lamp Works, Nela Park, Cleveland, in an endeavor to reduce shrinkage and increase production. The principal trophy was awarded to F. C. Kirchner, general manager of the Youngstown plant. Two cups also were awarded, for shrinkage and for production. In the miniature lamp contest the award went to the Cleveland Miniature Lamp Division, W. H. Stiles manager.

It has been the experience of the National Lamp Works that contests are a most effective means of getting quick and extraordinary results in either the selling or the manufacturing field. In the case of the "ballot-box battle" the increase in production attained was equivalent to normal output of several standard lamp factories, while the proportion of lamps spoiled in manufacture was reduced by a large percentage. A distinct improvement in morale throughout the organization is also noted during these contests.

Macbeth-Evans Cuts Line to Standardize

Sales instructions are just going out from the Macbeth-Evans Glass Company, Pittsburgh, Pa., that in order to provide unit production and to effect a standardization of the company's products the line of glassware has been reduced from 6,000 to 550 items. The company is aiming to concentrate its production on these items and produce for stock, expecting in the near future to have stocks sufficient to warrant shipments in seventy-two hours. To this end some other departments of the company are now assisting the electrical glassware department, which is running to capacity, to build these lines for stock.

Blaw-Knox Sends Engineer to Japan to Design Steel Towers

E. L. Gemmil, chief engineer of the structural department of the Blaw-Knox Company, Blawknox, Pa., has sailed for Japan, where he will design the transmission towers for the new high-tension line of the Tokyo Electric Power Company. The contract, which was closed a few weeks ago, calls for 5,000 towers.

Forty-Ton Electric Steel Furnace in Operation

About three weeks ago the United States Steel Corporation placed in operation a battery of two 40-ton hot-steel electric furnaces of the Heroult type for the United States naval ordnance plant at Charleston, W. Va. Although 30-ton furnaces have been built by this corporation and operated for nearly two years, this new furnace is said to be the largest hot-steel electric furnace ever built, and the limit, it is thought, has not yet been reached.

It was designed for operation at 3,000 kw., using 24-in. carbon electrodes, but it has functioned properly, according to tests, at 2,350 kw., at which figure the power factor noted was 91, and it is probable that the electrodes will be reduced to 20 in.

Western Electric Sees Biggest Year for Farm Lights Ahead

At a sales conference on farm power-lighting plants held in Chicago by the Western Electric Company, Feb. 1-5, the consensus of opinion was that the year 1921 will record the biggest sales of farm-lighting plants in the history of the company. The meeting was attended by the Western Electric district managers, the managers and sales managers of all branch houses and the company's power-light specialists.

The general purpose of the meeting was to discuss sales possibilities for the present year and to outline a plan of action. The latter will include a campaign of education on a scale never before attempted, intended to reach the farmer direct, through advertising in about forty sectional and state farm papers. Optimism over the outlook was freely expressed, and regarding present conditions the general opinion was that business is not bad, but just hard to get.

Universal Chain to Open New Mill

The Universal Chain Company, Stroudsburg, Pa., expects to open within about thirty days a new wire mill—that of the Pennsylvania Steel Wire Company. This mill will draw wire of any cross-section for the manufacture of lighting fixtures. A Chicago office will be opened at about the same time, with P. E. Pollano, general sales manager, in charge.

The Elliott Company, Jeannette, Pa., held a convention from Feb. 10 to 12 inclusive for its sales organization, which was attended by all the district managers, sales engineers and sales agents of the company. An exhaustive study was made of the Elliott products, and addresses were given by the engineers and experts of the company as well as those of the Lagonda Manufacturing Company and the Liberty Manufacturing Company.

The Acme Wire Company, New Haven, Conn., announces the opening of its Chicago office at Room 1105, Monadnock Block, 53 West Jackson Boulevard, in charge of H. B. Bassett. The company also maintains branch offices in the Guardian Building, Cleveland, in charge of J. T. Crippen, and in New York City at 52 Vanderbilt Avenue, in charge of H. S. Glasby.

The Lionel Corporation, Irvington, N. J., manufacturer of electrically operated toys, batteries, etc., is planning to erect a one-story addition to its plant, 30 ft. x 60 ft.

The Splitdorf Electrical Company, 2900 South Michigan Avenue, Chicago, is reported to be receiving bids for the construction of a six-story building, 120 ft. x 300 ft., at Twenty-second Street near Fifty-fourth Avenue, Cicero, Ill., to cost about $700,000.

The Harter Manufacturing Company, 522 South Clinton Street, Chicago, is having plans prepared for the construction of a one-story factory, 100 ft. x 125 ft., at Lincoln and Fullerton Streets, to cost about $50,000. The company manufactures electric light fixtures.

The Maring Wire Company, Muskegon, Mich., manufacturer of cotton-covered and enameled magnet wire, announces the appointment of the Beedle Equipment Company as its representative. The Cincinnati office, at 1309-10 Union Trust Building, is in charge of A. L. Beedle. The Indianapolis office, at 509-10 Lemcke Building, is in charge of F. T. Miles.

The National Lamp Works of the General Electric Company, Nela Park, Cleveland, has awarded contract for the construction of a factory, 80 ft. x 200 ft., two stories, at its new Indianapolis plant. The cost, including machinery, is estimated at about $200,000.

The Duplex Storage Battery Company, Beaver Dam, Wis., has recently been reorganized with the following officers: J. W. Deniger, Beaver Dam, president; Herman L. Schickel, Milwaukee, vice-president; M. A. Jacobs, Beaver Dam, secretary and treasurer, and Peter M. Kettenhofen, general manager. The company recently removed its plant from Milwaukee and now occupies the former works of the Beaver Dam Manufacturing Company.

The Combustion Engineering Corporation, 11 Broadway, New York City, has established a branch office at 521 Candler Building, Atlanta, Ga., in charge of A. A. Hutchinson.

The Electric Service Supplies Company, Seventeenth and Cambria Streets, Philadelphia, held a sales meeting at the Philadelphia plant the first week in February which was attended by the sales force covering the Eastern territory The daily discussions of the business conditions in the central station, railway, mining and industrial fields indicated recent increased activity and an optimistic outlook for the future.

The Motor Company, Winston-Salem, N. C., has opened a branch house at 633 South Elm Street, Greensboro, N. C. The company will handle the Lalley light and power plants, "Laundry Queen" electric washing machines, "Eureka" vacuum cleaners and other well known labor-saving devices and appliances for the farm and the home. O. C. Nance and Harry Sadler will be in charge of the Greenfield branch.

The Hart & Hegeman Manufacturing Company, Hartford, Conn., has filed notice of increase in capital stock of $84,000, making the total outstanding capitalization $105,000.

The Oriole Electric Manufacturing Company, Norwalk, Conn., has filed notice of change in name to the King-Craymer Electric Manufacturing Company.

Farley & MacNeill, 107 Federal Street, Boston, dealers in electric fixtures and supplies, it is reported, have leased the five-story building at 62-64 Stanhope Street, comprising about 16,000 sq.ft. of floor space, to be used as a storage-battery manufacturing plant.

The Cook Electric Company, Greenfield, Mass., manufacturer of electric products, is being reorganized. Charles I. Cook has disposed of his interest to C. E. Parson, who will head the company. Edgar M. Graves is also interested in the firm.

Foreign Trade Notes

FAIR TO BE HELD IN NETHERLANDS EAST INDIES. — Announcement has been made, according to the London *Electrician*, that the second Netherlands East Indies Fair will be held at Bandoeng, Java, from Sept. 19 to Oct. 9 this year. The fair will be international in character and will offer manufacturers an opportunity of exhibiting wares of all kinds. Everything pertaining to industry, commerce and agriculture will be presented.

HYDRO-ELECTRIC PROJECT IN LIRO VALLEY, ITALY.—The Società Idroelettrica Cisalpina, Milan, Italy, formed in March, 1919, with a capital stock of 2,000,000 lire, it is reported, has decided to increase its capital to 30,000,000 lire for the purpose of carrying out proposed hydro-electric project in the Liro Valley.

MANUFACTURE OF ELECTRIC COOKING RANGES IN ITALY.—With the object of manufacturing electric cooking ranges of the thermal storage type and all other thermo-electrical apparatus for household and industrial purposes, fourteen large Italian concerns have become partners in a company, known as the Società Italiana per l'Accumulazione Termoelettrica, Milan, recently organized with a capital stock of 5,000,000 lire.

DEMAND FOR ELECTRICAL SUPPLIES IN CHINA.—There is an increasing demand in Canton, China, for electrical supplies, the principal item being fans and accessories. There is also a demand for small electric generating units of about 2 kw. for use in government offices, homes of wealthy Chinese and a few factories. A growing market in this district for electric power plants and equipment also exists.

TELEPHONE INSTALLATIONS IN MANCHURIA.—Since the installation of American telephones in the city of Mukden the service has been so greatly improved, according to Consul-General Pontius, that it is now proposed to extend the service throughout the entire province of Fengtien. Of the fifty-six counties only twenty-six have telephone installations at present, the instruments for most part being of a very cheap grade imported from Japan. The provincial government is desirous of administering the telephone system of the province and is prepared to take over all the apparatus now in operation. The cost of providing the entire province with a new and adequate system is estimated at about $3,000,000 (Mexican).

NEW TARIFF ON ELECTRICAL GOODS IN SPAIN.—Official confirmation has been received at Washington that a new general tariff will be promulgated on March 20 to go into effect probably forty days after promulgation. Increased rates on electrical goods are expected, but the amount of increase has not been definitely decided.

New Apparatus and Publications

LINE EQUIPMENT. — The Electric Power Equipment Corporation, Thirteenth and Woods Stret, Phieladelphia, has issued bulletins Nos. 103, 104, 200, 202, and 600, covering its indoor choke coils, copper fittings, pole-top switches, outdoor bus supports and control switches respectively.

WATER HEATER.—The Electric Boiler Corporation, 475 Main Street, Cambridge, Mass., has issued a booklet entitled "Electric Boilette," describing an electrically heated and automatically controlled hot-water tank.

MOTOR DRIVE. — "Sectional Individual Motor Drive for Paper Machines" is the subject of leaflet 1933 of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

MOTORS.—Leaflet 1160-A of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., gives the features of the type CS squirrel-cage induction motors.

POWER STAND.— The 32-volt power stand manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is illustrated and described in folder No. 4448, entitled "Do Your Chores Electrically."

MOTORS.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 48143.1, describing its alternating-current mill motors, type MI and MIS, for service in steel plants.

ELECTRIC TRUCKS.—The Commercial Truck Company, Philadelphia, is distributing a four-page leaflet describing its C-T electric trucks.

IRONERS.—The Western Appliance Manufacturing Company, 1405 L. C. Smith Building, Seattle, is distributing a folder describing its new "Mercer" electric ironer.

BRAKES.—The Cutler-Hammer Manufacturing Company, Milwaukee, has issued publication 850, describing and illustrating its electrically operated C-H brakes.

BATTERY TEST CHART.—The Allen-Bradley Company, Milwaukee, has published a new battery test chart, 14 in. x 31 in., to be used exclusively with the Allen-Bradley rate discharge test set.

ELECTRIC REFRIGERATORS. — "The Most Modern Household Utility" is the title of a small booklet published by the Colfax Company, Chicago, describing and illustrating its electric refrigerator.

BATTERY-CHARGING EQUIPMENT.—The Automatic Electrical Devices Company, 120 West Third Street, Cincinnati, has issued bulletin 620, illustrating its various types of fixed resistance charging panels for industrial trucks and locomotive service. Bulletin 621 covers its "Unipanels," sectional battery-charging equipment for charging industrial trucks, storage-battery locomotives, electric commercial vehicles and starting and ignition batteries.

SOLDERING IRONS.—The Baco Electric Company, Bode, Iowa, is distributing two leaflets, one describing the Baco electric soldering iron and the other the Baco electric "Soderwand."

PORTABLE ELECTRIC GRINDERS AND DRILLS.—The Cincinnati Electrical Tool Company, Cincinnati, has issued catalog No. 14, covering its complete line of portable electrical drills, grinders and buffers.

MOTORS.—The General Electric Company, Schnectady, N. Y., has issued bulletin No. 481,00A describing its commutating-pole direct-current crane and hoist motors, CO-1800 line.

COLOR FILTER.—The Holophane Company, New York City, has developed a color filter for use with its window-lighting reflector No. 922.

LIGHTING FIXTURES. — Circular 7A-C-2 issued by the Westinghouse Electric & Manufacturing Company, George Cutter Works, South Bend, Ind., describes the Westinghouse "Luxsolite" fixtures for street lighting.

RESISTOR FOR HEATING DEVICES. —The National Electrical Supply Company, 1328 New York Avenue, Washington, D. C., is manufacturing a new resistor for heating devices, rheostats, instruments, etc., designated as "calorel ribbon."

SWITCHES FOR BATTERY CHARGING. — The Automatic Electrical Devices Company, 122 West Third Street, Cincinnati, has placed on the market a heavy duty self-closing underload switch (type M), with ratings of 50 amp. to 200 amp., designed for charging large storage-battery mining locomotives.

INSULATING MATERIAL.—The Boonton Rubber Manufacturing Company, Boonton, N. J., has published a forty-eight-page booklet entitled "Boonton Bakelite," in which it describes and illustrates the method of manufacturing bakelite and its uses.

VALVES. — The Yarnall-Waring Company, Chestnut Hill, Philadelphia, is distributing a leaflet describing its "Yarway" junior seatless valve.

HOIST.—The Revolvator Company, 327 Garfield Avenue, Jersey City, has issued bulletin No. 58, describing its electric motor-driven revolvator for stacking merchandise.

New Companies

THE OPALESCENT ART COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $73,000. The incorporators are M. L. Rogers, L. A. Irwin and W. G. Singer, Wilmington. The company proposes to manufacture lamp shades, electric signs, etc.

THE NATIONAL ELECTRIC MANUFACTURING COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $600,000. The incorporators are M. L. Rogers, L. A. Irwin and W. G. Singer, Wilmington.

THE WATTS COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $225,000. The incorporators are F. R. Hansell, J. Vernon Pimm and E. M. MacFarland, Philadelphia. The company proposes to manufacture electrical and mechanical engines.

THE S. L. ANDERSON ELECTRIC SERVICE COMPANY, New York, N. Y., has been incorporated with a capital stock of $10,000 by H. G. Saulmer, A. T. Rose and S. L. Anderson, Stony Point.

THE CRYSTAL ELECTRIC COMPANY, New York City, has been incorporated with a capital stock of $5,000 by E. H. Schwartz, L. G. Herman and E. Carter, 944 Aldus Street.

Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 25, 1921)

1,367,224. RADIO-RECEIVING SYSTEM; Harold De Forest Arnold, East Orange, N. J. App. filed Jan. 5, 1916. Telephony and telegraphy.

1,367,258. MARINE TELEGRAPH; Charles J. Henschel, Brooklyn, N. Y. App. filed March 28, 1919. To transmit signals to different parts of vessel.

1,367,267. SANITARY ATTACHMENT FOR TELEPHONES; Henry C. Karlson, Borough of Hasbrouck Heights, N. J. App. filed Feb. 5, 1920. For attachment to mouthpieces of transmitters.

1,367,283. RATCHETING MECHANISM; Arthur Simon, Milwaukee, Wis. App. filed June 26, 1916. Solenoid ratcheting mechanism.

1,367,285. TESTING BLOCK; Martin M. Stimmel, San Francisco, Cal. App. filed March 3, 1920. For lamps, fuses, etc.

1,367,287. STORAGE BATTERY; Alfred J. Trigwell, San Jose, Cal. App. filed Dec. 29, 1919. Separators reinforce plates.

1,367,288. BATTERY PLATE; Alfred J. Trigwell, San Jose, Cal. App. filed April 16, 1920. Provides for expansion by heat.

1,367,298. ALTERNATING-CURRENT MOTOR AND GENERATOR; James Burke, Erie, Pa. App. filed Feb. 8, 1917. For regenerative operation.

1,367,305. TELEGRAPHY; George C. Cummings, East Orange, N. J. App. filed Aug. 7, 1918. Duplex.

1,367,319. MOTOR-GENERATOR SYSTEM; Carlton L. Kennedy, South Braintree, Mass. App. filed Oct. 23, 1916. To prevent excessive starting current.

1,367,338. SWITCHING MECHANISM; Harry G. Webster, Chicago, Ill. App. filed Dec. 26, 1916. Trunk telephone.

1,367,341. ELECTRIC HEATING UNIT; Charles C. Abbott, Pittsfield, Mass. App. filed Nov. 15, 1918. Resistance conductor inclosed in metallic sheath.

1,367,352. METHOD OF AND DEVICE FOR CONTROLLING ELECTRIC ARCS; Daniel F. Comstock, Brookline, Mass. App. filed Oct. 20, 1915. Projection apparatus.

1,367,364. ELECTRIC FURNACE; Abraham M. Erichsen, Porsgrund, Norway. App. filed Nov. 28, 1919. Smelting furnaces.

1,367,409. PROCESS OF PRODUCING FERROUS OXIDE; Archibald J. MacDougall, Toronto, Ontario, Canada. App. filed Aug. 21, 1920. Electrolytic.

1,367,442. ELECTRIC RESISTANCE HEATER FOR MELTING FURNACES; Alfred von Zeerleder, Geneva, Switzerland. App. filed Dec. 22, 1919. Three-phase resistance heater.

1,367,463. ELECTRIC WATER HEATER; Herbert W. Christian, Detroit, Mich. App. filed Dec. 19, 1919. For hospitals, residences, etc.

1,367,472. DEVICE FOR CONCENTRATION OF LIGHT RAYS; Walter J. Harvey, Toronto, Ontario, Canada. App. filed Nov. 26, 1917. Therapeutic and ophthalmic work.

1,367,486. MAGNETO-ELECTRIC MACHINE; Leonard Le Baron and Arthur C. Harrell, Pensacola, Fla. App. filed Feb. 24, 1920. Steady and uniform rotation.

1,367,489. TOILET ARTICLE; Patrick McGuire, Superior, Wis. App. filed May 8, 1920. Hair curler and dryer.

(Issued Feb. 8, 1921)

1,367,534. SELF-WINDING ATTACHMENT FOR SECONDARY CLOCKS; James W. Bryce, Binghamton, N. Y. App. filed Nov. 17, 1919. Master-control system.

1,367,535. WIRE HOLDER FOR TROLLEYS; John Bulthouse, Chicago, Ill. App. filed Sept. 8, 1919. For retaining wheel in proximity to wire.

1,367,552. METHOD OF ELECTRIC WELDING; Charles H. Kicklighter, Atlanta, Ga. App. filed July 28, 1919. Spot welding.

1,367,553. METHOD OF JOINING METAL BY ELECTRIC WELDING; Charles H. Kicklighter, Atlanta, Ga. App. filed July 28, 1919. Spot welding.

1,367,562. ELECTRICAL ATTACHMENT PLUG; Johann G. Peterson, Jersey City, N. J. App. filed Nov. 23, 1917. Leads connected simply.

1,367,567. ELECTROPLATING MACHINE; Harry A. Sedgwick and Patrick J. Sheehan, Milwaukee, Wis. App. filed March 3, 1917. Continuous action.

1,367,571. TRANSMISSION-EQUALIZATION ARRANGEMENT; George K. Thompson, Maplewood, N. J. App. filed Oct. 2, 1919. Telephone.

1,367,583. SYSTEM FOR SIGNALING; Bornett L. Bobroff, Milwaukee, Wis. App. filed April 2, 1918. Annunciator.

1,367,586. IGNITION GENERATOR; Paul H. Brandt, Cleveland, Ohio. App. filed Aug. 23, 1917. Inductor alternator.

1,367,590. TRANSMISSION CIRCUITS; Charles S. Demarest, Brooklyn, N. Y. App. filed May 17, 1919. Telephone signal.

1,367,592. STARTING AND SPEED-LIMITING DEVICE FOR ELECTRIC MOTORS; Joseph E. Feller, Brooklyn, N. Y. App. filed April 13, 1917. Automatic.

1,367,593. SECONDARY OR STORAGE BATTERY; Bruce Ford, Philadelphia, Pa. App. filed April 14, 1916. Rugged.

1,367,594. STORAGE BATTERY; Bruce Ford, Philadelphia, Pa. App. filed Aug. 16, 1919. To avoid introduction of dust when filling.

1,367,595. STORAGE BATTERY; Fruce Ford, Philadelphia, Pa. App. filed Nov. 5, 1919. To keep cover from warping.

1,367,598. TROLLEY-WIRE CLAMP; Georges E. Henry, Mansfield, Ohio. App. filed May 13, 1920. Suspension.

1,367,599. CONDUCTOR SUPPORT; Georges E. Henry, Mansfield, Ohio. App. filed June 19, 1920. Trolley-wire clamp.

1,367,613. TRANSLATING DEVICE; William W. MacFarlane, Philadelphia, Pa. App. filed Nov. 22, 1917. Induction coils.

1,367,618. WIRE SUPPORT; Samuel S. Matthes, Mansfield, Ohio. App. filed June 11, 1920. Trolley-wire clamp.

1,367,619. WIRE CLAMP; Samuel S. Matthes, Mansfield, Ohio. App. filed Sept. 30, 1920. Trolley.

1,367,679. MOTOR-SPEED CONTROL; Frank W. Adsit and Benjamin B. Bienhoff, Minneapolis, Minn. App. filed March 1, 1919. Low rate of speed with maximum torque.

1,367,705. AUTOMATIC TELEPHONE SYSTEM; Charles W. Keckler, Newark, N. J. App. filed March 21, 1917. Substation sending devices.

1,367,708. SUBMARINE PROPULSION SYSTEM; Robert V. Morse, Ithaca, N. Y. App. filed April 26, 1915. Greatly increased power for limited periods.

1,367,717. PRINTING-TELEGRAPH SYSTEM; Paul M. Rainey, Glen Ridge, N. J. App. filed Nov. 15, 1917. Multiplex systems of secret service.

1,367,727. ELECTROMAGNETIC DEVICE; James A. Wotton, Montclair, N. J. App. filed Aug. 29, 1917. Relays having retractable armatures.

1,367,729. TELEGRAPH SYSTEM; George H. Bell, South Orange, N. J. App. filed April 17, 1918. Repeater system.

1,367,733. TELEGRAPH SYSTEM; George C. Cummings, East Orange, N. J. App. filed Dec. 27, 1918. Repeater system.

1,367,734. CONSTRUCTION OF REACTANCE COILS; Austen M. Curtis, Brooklyn, N. Y. App. filed Aug. 16, 1917. Radio.

1,367,735. PRINTING-TELEGRAPH SYSTEM; Amos F. Dixon, Newark, N. J. App. filed Aug. 1, 1917. Selecting switch mechanism.

1,367,746. EAR SHIELD; William J. Kent, Brooklyn, N. Y. App. filed July 16, 1918. For use by aviators.

1,367,774. SIGNALING SYSTEM; Joseph C. Field, Orange, N. J. App. filed April 13, 1918. Selectively operated signal control.

1,367,781. ELECTRIC POCKET LAMP; J. Oskar Junghans, Schramberg, Germany. App. filed Oct. 10, 1916. Manually operated flashlamp.

1,367,796. METAL WORKING BY ELECTRICITY; Charles A. Cadwell, Cleveland, Ohio. App. filed June 26, 1919. Copper welding.

1,367,804. STARTING AND LIGHTING SYSTEM; Thomas R. Du Bois, Niagara Falls, N. Y. App. filed Aug. 28, 1916. Automobile.

1,367,811. CABLE-WINDING DEVICE; Walter F. Grams, Venice, Cal. App. filed Sept. 25, 1919. For winding tape.

1,367,833. TERMINAL BANK FOR SELECTORS; John N. Reynolds, Greenwich, Conn. App. filed Feb. 5, 1917. Automatic telephone.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

MANCHESTER, N. H. — The Mooer's Falls Company, recently organized by H. F. Straw, W. M. Parker of Manchester and others, contemplates the harnessing of the Merrimac River at Mooer's Falls, a few miles south of Manchester and near Goff Falls, for the development of water power. Report of the surveys of the project has been filed.

LOWELL, MASS. — At a recent town meeting it was voted to set aside the sum of $11,300 for the lighting of Main Street from the Lowell line to Foster's Corner.

HARTFORD, CONN. — The Connecticut Power Company, controlled by the Hartford Electric Light Company, will furnish electric energy for the operation of the Thames River Highway Bridge.

Middle Atlantic States

ALBANY, N. Y.—Bids will be asked in March by E. S. Elwood, secretary of the State Hospital Commission, for the construction of a new power house, and improvements to the present plant at one of the state institutions to cost about $125,000.

LONG ISLAND CITY, N. Y.—The Moto Meter Company, Wilbur Avenue, manufacturer of instruments for motor-car service, contemplates the erection of a power house, 16 ft. x 40 ft.

UTICA, N. Y.—The Utica Gas & Electric Company will start work immediately on the construction of a steam-turbine electric generating station at a point near the Mohawk River and the Barge Canal harbor channel. The plant, which is to be known as the Harbor Point Station, will be capable of developing an ultimate capacity of 50,000 hp. The cost is estimated at $1,750,000. W. J. Reagan is commercial manager of the company. T. E. Murray, Inc., New York City, is consulting engineer.

JERSEY CITY, N. J.—A bill has been introduced in the Legislature by Assemblyman H. Tuttle providing for a municipal lighting plant in all first-class counties. The bill will make it mandatory to issue bonds for the construction of an electric power plant for lighting county institutions, roads, and buildings which are owned or rented by the county.

NESHANIC STATION, N. J. — The Branchburg Township Committee will establish electric lighting in District No. 1 in Neshanic Station. An election will be held to arrange for the appropriation of a sum for lighting for the coming year.

WESTVILLE, N. J.—The West Jersey & Seashore Railroad Company contemplates improvements to its local power plant, including the installation of equipment for increased service.

ALTOONA, PA.—Changes to the street-lighting system in the outlying residential district are under consideration. It is proposed to replace the present arc lamps with 400-watt incandescent lamps. H. C. Hinkle is city manager.

HAGERSTOWN, MD.—The Hagerstown & Frederick Railway Company has completed the erection of a new 33,000-volt high-tension transmission line between Frederick and Mount Airy, a distance of 17 miles.

North Central States

CANTON, OHIO.—The American Forge & Machine Company has increased its capital stock to provide for the construction of a new power house and for other improvements.

DEFIANCE, OHIO. — Bids will be received at the office of the Director of Public Service of Defiance until Feb. 28 for furnishing one 24-kva. alternator, direct connected to a four-cycle gasoline engine; also transformers, switchboard, circuit breakers, voltmeter, ammeter, interior and exterior power and light wiring, lamps, conduits, pole line, etc., necessary to provide complete electric light and power circuits at the water-works plant. N. S. Hill and

S. F. Ferguson, 112 East Nineteenth Street, New York City, are consulting engineers.

KUTTAWA, KY. — The Public Service Company, recently incorporated with a capital stock of $15,000, contemplates the consolidation of the Kuttawa Water & Light Company and the Cumberland Electric Company. The erection and equipment of a power house is also planned. G. P. Ordway is president.

LACKEY, KY.—The Porter Mining Company, Second National Bank Building, Ashland, contemplates the construction of a power house in Lackey and the installation of two 250-kw. generating units. Electrical apparatus and coal-mining equipment will also be required for the mines. F. Blackburn is manager.

INDIANAPOLIS, IND. — The Board of School Commissioners is considering improvements to the lighting system in the various schools. The cost has been estimated at about $100,000.

PRAIRIE DU CHIEN, WIS.—The Prairie City Electric Company has increased its capital stock from $30,000 to $75,000. The company contemplates enlarging its plant.

KANSAS CITY, MO.—A special election will be held on April 7 for the purpose of submitting to the voters a proposal to issue bonds to the amount of $1,050,000 for extensions to the light, power and water systems. L. H. Chapman is commissioner of the light and water department.

MAPLEWOOD, MO. — Bonds to the amount of $12,000 have been authorized for the installation of electric lamps on the main thoroughfare.

MOBERLY, MO.—Bids will be received by W. H. Wilson, city clerk, until March 10 for water-works improvements, including dam and power house, 5 miles of three-phase electric transmission lines, 5 miles of telephone circuit, filter plant, pumping station, two 200-hp. horizontal water-tube boilers, four centrifugal pumps, one of 400, two of 700 and one of 2,250 g.p.m. capacity; 700 g.p.m. compound duplex steam pump, alternate on steam-turbine-driven centrifugal pump of the same capacity; 400-hp. open-feed water heater, etc. Fuller & Beard, Chemical Building, St. Louis, are engineers.

Southern States

NORTH WILKESBORO, N. C.—The Superior Mill Company is negotiating with the city authorities for permission to utilize the surplus flow of water at the dam on the Reddies River for power purposes. E. V. Williams is general manager.

ANDERSON, S. C. — The Centerville Electric Company, recently incorporated with a capital of $7,000, contemplates the erection of a 6-mile transmission line. W. C. Gilmer is president.

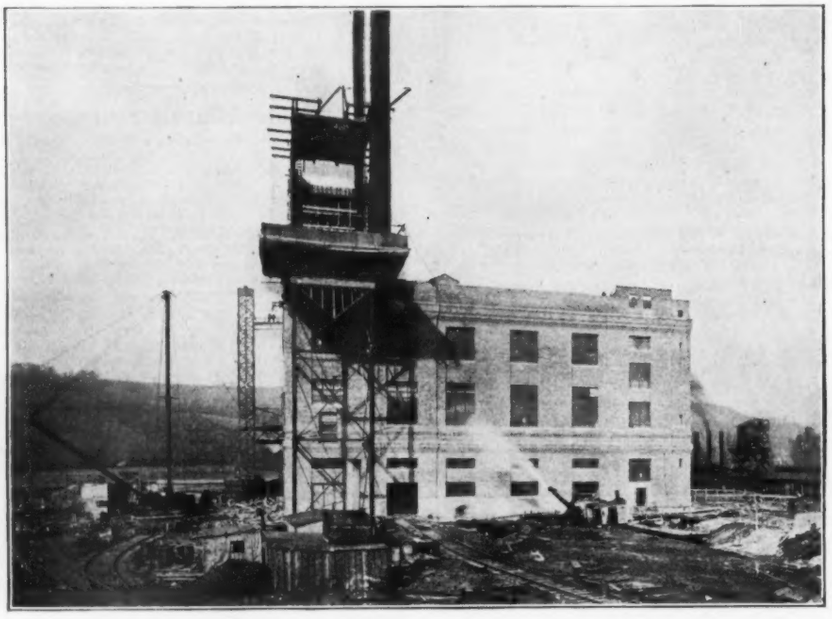
FORT PIERCE, FLA.—The proposal to issue $80,000 in bonds for improving and enlarging the light and water systems will be submitted to the voters.

BIRMINGHAM, ALA. — The Mountain Grove Creamery, Ice & Electric Company, Mountain Grove, Mo., contemplates establishing a business and plant at Birmingham to cost about $150,000.

GULFPORT, MISS.—The Casino Hotel Company, 316 Hennen Building, New Orleans, La., will receive bids until March 10 for the installation of an electric plant for land development purposes, about 8 miles from Gulfport. I. N. Wise is secretary.

ROGERS, ARK. — The Rogers Power Company, recently incorporated with a capital stock of $50,000, contemplates the construction of power house and dams at the White River near Rogers. The company will supply electricity in Rogers and nearby towns. M. McMichael, E. G. Sharp and others are incorporators.

MONROE, LA.—The Union Power Company, recently organized with a capital stock of $3,000,000, is a combination of the interests of the Frost-Johnson Lumber Company and J. E. Cullinann of Houston, Tex. The new company contemplates building a series of electric generating plants in the Monroe gas field for furnishing electricity for lighting in northern Louisiana, southern Arkansas, Texas and Mississippi.



POWER PLANT NOW UNDER CONSTRUCTION AT SEWARD, PA., FOR THE PENN PUBLIC SERVICE COMPANY BY DWIGHT P. ROBINSON & COMPANY, INC.

MARIETTA, OKLA.—F. A. Price and J. Curtis, both of Gainesville, have purchased the local light and water plant for $75,000. The new owners plan to make improvements in the near future to cost about $20,000.

MOUNTAIN VIEW, OKLA.—Bids will be received by V. V. Long & Company, engineers, 1300 Colcord Building, Oklahoma City, about March 10 for the construction of a power plant to develop 175 hp. and the erection of a one-mile transmission line. The cost of the plant is estimated at about $30,000.

TAHLEQUAH, OKLA.—The construction of a municipal electric light plant in Tahlequah has recently been completed. Work on the installation of an ornamental street-lighting system in the business section is well under way.

Pacific and Mountain States

VANCOUVER, WASH. — At a recent meeting of the City Council a resolution was adopted in favor of improvements to the street-lighting system.

FREEWATER, ORE. — C. H. Downing has filed application with the state engineer for permission to appropriate water from the Little Walla Walla River for hydro-electric power development and irrigation purposes.

LOS ANGELES, CAL.—Plans are under way for the installation of an ornamental street-lighting system, maintained by underground wires, in Eagle Rock.

PIRU, CAL.—Plans are under way for the installation of a lighting system in Piru.

RIVERSIDE, CAL.—The Southern California Edison Company, which supplies a large amount of electric energy consumed in Riverside, recently opened for operation its power house, 75 miles northeast of Fresno, known as Big Creek No. 2. The Kern River Power House No. 3, capable of generating 40,000 hp., will be opened on March 1.

SACRAMENTO, CAL. — The Excelsior Water & Mining Company has applied to the state engineer for permission to divert 200 cu.ft. of water from Deer Creek by means of a concrete dam and a canal 9.88 miles long. The company also asks authority for the diversion of 200 cu.ft. from the same source by means of a dam 120 ft. long and a canal 5.2 miles long. The development of these power projects is estimated at about $1,880,000.

SAN FRANCISCO, CAL.—J. H. Hughes has made application for the diversion of 28 sec.-ft. of water from French Creek, tributary of North Fork Feather River, in Butte County, for power purposes. The cost is estimated at about $150,000.

SANTA MARIA, CAL.—The San Joaquin Light & Power Corporation has work under way on the reconstruction of its distribution lines in Santa Maria. Several extensions to the lighting system have also been made recently.

VENICE, CAL. — The City Council is considering the construction of an electric light plant. It is proposed to issue bonds to finance the work.

CORRINE, UTAH.—A new street-lighting system will be installed in the town of Corrine. Work will be started at an early date.

EPHRAIM, UTAH.—The Ephraim Commercial Club recently adopted a resolution favoring the installation of an ornamental street-lighting system.

PARK CITY, UTAH.—The Judge Mining & Smelting Company, Salt Lake City, has applied to the state engineer for permission to divert 30 sec.-ft. of water from Snake Creek tunnel, Wasatch County. The company plans to develop approximately 2,000 hp. for mining and other purposes in Park City and elsewhere in Utah.

RICHMOND, UTAH.—Extensions to the street-lighting system in the town of Richmond are under consideration. Electric service is supplied by the Utah Power & Light Company.

TRENTON, UTAH.—Extensions to the street-lighting system in Trenton are under consideration. Electric service is supplied by the Utah Power & Light Company.

MONTPELIER, IDAHO. — Extensions to the street-lighting system in this town are being considered. Electric service is supplied by the Utah Power & Light Company.

PRESTON, IDAHO.—Extensions to the street-lighting system in Preston are under consideration. Electric service is supplied by the Utah Power & Light Company.

CASA GRANDE, ARIZ.—A special election will be held on March 12 for the purpose of submitting to the voters a proposal to issue bonds to the amount of $30,000 for improvements to the municipal electric light and power plant.

MILLERS, NEV. — The Simon Silver-Lead Mines Company has surveys under way and contemplates early erection of a 38-mile electric transmission line from Millers to the Simon district. Energy will be supplied by the Nevada-California Power Company.

Canada

ALVINSTON, ONT. — Estimates of the cost of the installation of a hydro-electric system in Alvinston will be prepared by the Hydro-Electric Power Commission of Ontario. A by-law will be submitted to the ratepayers.

Miscellaneous

SANTA ROSALIA, MEXICO.—The water supply created by the great dam on the Conchos River at Boquillas, about 18 miles from here, it is stated, is to be used for irrigating more than 200,000 acres of land in the Conchos River Valley. This dam and the large hydro-electric plant are owned by the Northern Mexico Power Company of Santa Rosalia. The main canal will be about 130 miles long. The state government plans to build a dam across the San Pedro River to cost about $15,000,000, and the reservoir thus created will have a capacity of 1,000,000,000 cu.ft. of water. B. R. Enriquez is chief engineer of the irrigation department of the State of Chihuahua.